CONSTRUCTION • OPERATIONS • MAINTENANCE

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PIPE LINE INDUSTRY

JUNE
1957

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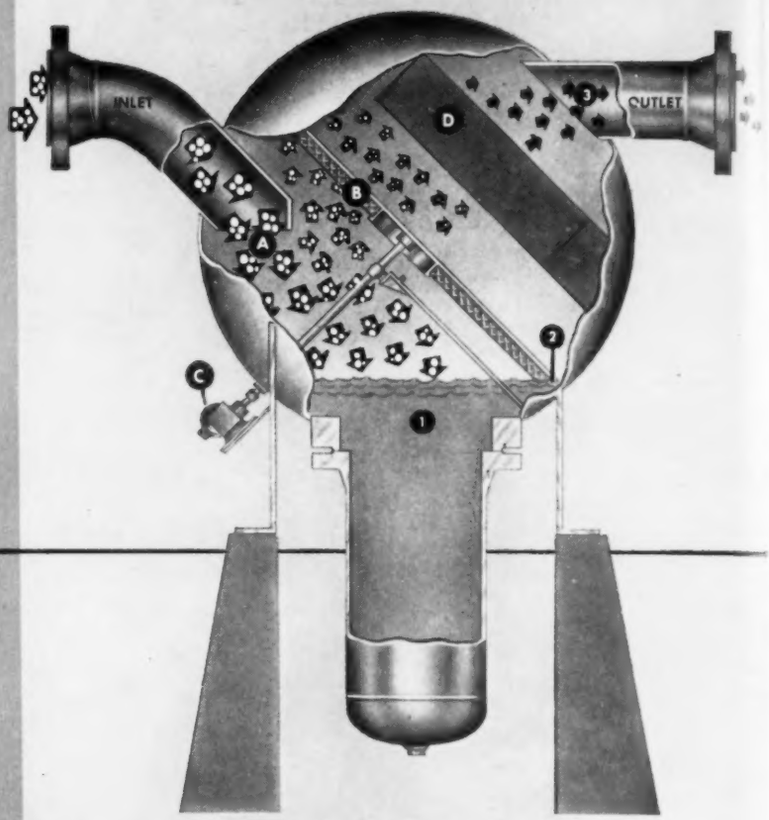
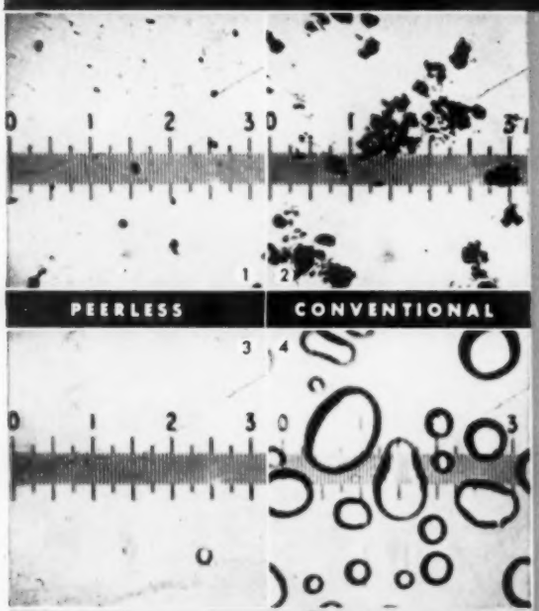


(A) The majority of incoming liquid and solid particles are directed down into reservoir. 1

(B) Lighter solid particles carried by gas stream are separated on surfaces of contactor which are kept wet and clean by revolving through liquid reservoir. 2

(C) Contactor is revolved by explosion-proof gear motor.

(D) Mist Extractor removes any remaining liquid particles from gas stream prior to outlet. 3



These photographs were made of microscope slides introduced downstream of the Scrubosphere and a conventional vertical oil bath cleaner under the same operating conditions. Plates 1 and 2 show the comparative amounts of iron oxide not removed with the amounts introduced being identical. Plates 3 and 4 indicate comparative oil loss with vapor rate through the vessels being the same.

LOOK AT THIS TEST The test at the left indicates the superiority of Peerless Scrubosphere over conventional oil bath dust scrubbers. The SCRUBOSPHERE operates with no loss of efficiency at low flows, minimum liquid loss, and very low pressure drop. Other outstanding features include easy vessel access with removable self-cleaning contactor, a sump for slugs of solid or liquid particles, and minimum cost.

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PIPE LINE INDUSTRY

CONTENTS and Quick Look

June, 1957 Vol. 6, No. 6

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Designing the Modern Centrifugal Pump

☐ Fitting the right pump to the particular job and providing for versatility in future operations calls for knowledge of both design theory and field experience. Here are some ideas to help the pipe line engineer select the right unit for any range of conditions.

By Val Lobanoff ..... Page 36

Products Line Conquers Iranian Mountains

☐ Laying a pipe line across deserts, rugged mountain ranges and beneath a network of irrigation ditches required all the skill in the contractor's bag of tricks. Here is the story behind construction of the new $32 million products line from Abadan to Teheran. It is the highest line yet built in the Middle East. Some of the lessons learned should be of real value in building future lines there. ..... Page 41

Modern Automatic Units Boost Capacity

☐ Rancho Pipe Line system's new remotely controlled Katy (Texas) station has protective devices ranging from motor overload to pump-seal-leakage shutdown. The station can be fully operated and monitored from the Houston dispatching office. ..... Page 44

Economics of Cathodic Protection Design

☐ Cost of corrosion control measures is an important consideration in pipe line economics. Here are some helpful pointers for making cost studies in ground bed design, selection of rectifiers and location of units.

By B. J. DeHanas ..... Page 46

A Practical Approach to Gas Flow Studies

☐ Southern Natural Gas Company engineers used the results of more than 200 field tests in developing a new approach to gas flow calculations. The goal is an equation that can be used with manual computation or adapted to digital computers.

By William T. Ivey and James H. Dorough . Page 49

Know the Facts About Pump Packings and Seals (Part 1)

☐ This series presents a handbook of facts about all types of packings, glands and mechanical seals. It will help you select the right packing or seal for particular pump operating conditions. Installation suggestions and maintenance pointers will save time and money.

By Harold Woodhouse ..... Page 55

Find Beam Deflections by Easy Methods (Part 1)

☐ Here are some easy methods to bypass the lengthy calculations necessary to find beam deflections. Station construction men will be interested in these "uniform-loading" shortcuts.

By Charles H. Fork ..... Page 59

How to Get Longer Life from V-Belts

☐ Check these suggestions that will help you get top performance and long life from V-belt drives. Careful attention to drive set-up and alignment is the key to proper installation. Periodic inspection of belts and sheave grooves minimizes maintenance.

By W. S. Worley ..... Page 64

How to Say What You Mean

☐ Success or failure of pipe line management-employe communications depends on one factor—ability of group to describe and share similar experiences with the other group. This is just as true with individual communications. Be sure to read the six questions each person should answer before communicating. They will tell you whether you "say what you mean."

By Anatol Rapoport ..... Page 67

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PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas, under the act of March 3, 1879.

Let the Consumer Decide

Consumers are the finest of people. Naturally. Nearly all of us buy products.

When properly informed—allowed to weigh both sides of an issue—they are usually fair in their judgment. When not properly informed they can foment untold problems for an industry.

An excellent example is the plight of natural gas producers in Washington. At the last report only two facts were certain in the Harris-O'Hara Natural Gas Bill debate:

- The producers don't like the bill in its present form.
- They are even more strongly opposed to the two amendments the Eisenhower administration has added.

In fact, there is general concurrence that the amendments—allowing the Federal Power Commission to use cost as a basis for determining producer prices and to review definite pricing clauses in gas contracts—would keep natural gas producers in the same untenable position they have occupied since the 1950 Phillips decision. Only this time federal control of wellhead prices would be sanctioned by an act of Congress instead of Supreme Court "legislation."

Serious economic problems would be created by such a bill for the oil industry, the consumer and the nation. This fact has been backed up by statistics time and again in producers' arguments before countless committees in the Phillips Case—in support of the Kerr Bill—in support of the Harris Bill—and in debating the Harris-O'Hara Bill.

Such a bill would give advocates of creeping socialism the wedge they have been waiting for. Once the foot is in the door, there will be nothing to stop the federal government from controlling each industry operating "in the public interest." This would include every segment of the oil industry, all minerals, every commodity with a price tag. The consumer, as well as industry, will be the loser. History has proved that federal control of anything dries up the source of supply—puts a steel band of red tape around progress.

Such a bill would tend to keep natural gas within the limits of the states producing it. To give but one example of how this is already happening, 27 years ago Texas marketed within its borders only 25.7 percent of the natural gas it produced. The percentage was 52.1 in 1955. Of the 4.7 trillion cubic feet of natural gas marketed in Texas last year, transmission lines took 4.1 trillion cubic feet, and exported only 2.5 trillion. Consumers in non-gas producing states are the losers. They can't use an inexpensive, efficient fuel they can't get.

These are just a few of the ill effects that will continue if the Harris-O'Hara Bill is passed in its present form. If this is all that producers can accomplish after seven years of trying to reason with Washington legislators, perhaps another approach should be considered.

Why not take the facts to the "Grass Roots"? Here is the reasoning behind this suggestion:

Senators and Congressmen represent the residents of their respective areas. They are representing the interests of those people, thus they will consider an issue in accordance with the wishes—or votes—of the majority. Whether fairness (or votes) is the guiding force in decisions to back or oppose a bill might well be a question.

There is only one hitch in this premise. Sometimes the people know only one side of an issue, and end up asking for support of a half-truth.

People in some areas believe (many are told) the price they pay for natural gas is too high. They have been told the producer is the culprit. Their city leaders, and some consumer groups, put pressure on their Washington legislators to hold back on natural gas prices, even if it means federal control of producers. The result: A Harris-O'Hara Bill goes in the hopper.

The people can hardly be blamed. They know only what they have been told. And they have been told little or nothing about the producers' side of the issue—nor have they been told of the dangers of federal control of industry. Yet the feelings of these people determine the actions of their senators and congressmen!

This should be reason enough to take the producers' story to the consumers. There is just one word of caution: The success of any "Grass Roots" effort depends entirely upon education through logic and reason. It is not only *what* is said that counts—but *how* it is said.

Why not give the consumer a chance? He could be the producers' staunchest supporter.

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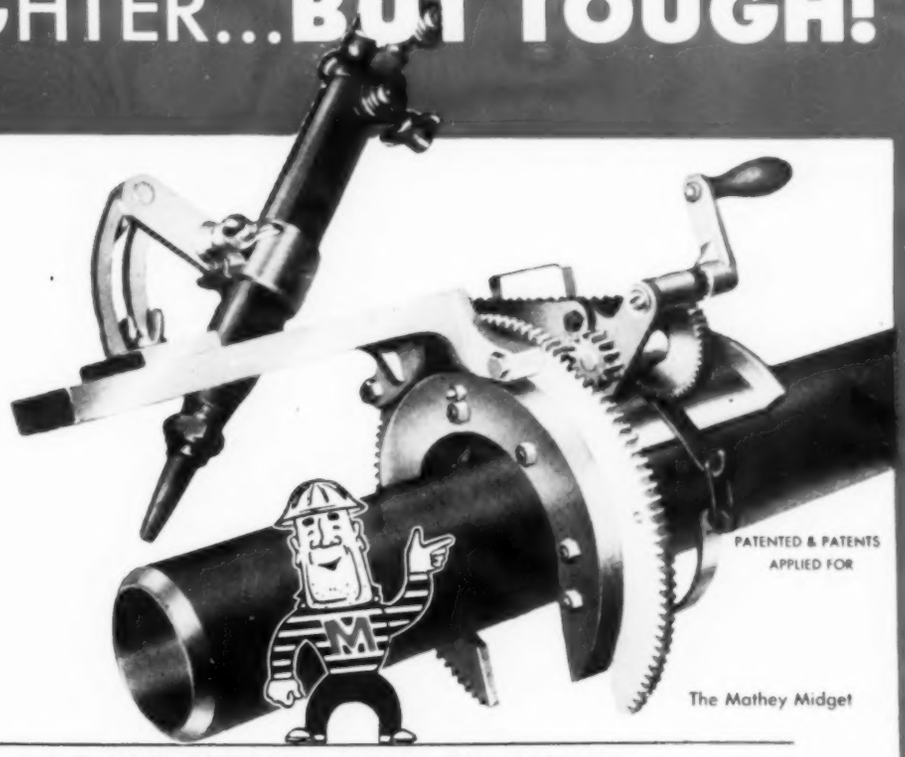

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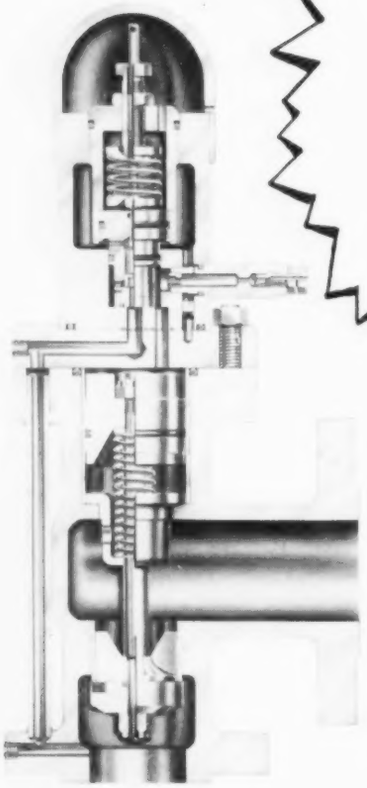

MODEL 416 RELIEF VALVE ASSURES POSITIVE PROTECTION

The new pilot operated Kinzbach Model 416 Relief Valves were designed to be the most dependable relief valve for gas services. Whenever line pressure reaches set pressure the pilot valve opens and full line pressure is applied to the main valve, opening it through its full stroke without pressure accumulation.

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For complete details on this and other Kinzbach Relief Valves, write for new catalog.

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PETROLEUM REFINER and THE REFINERY CATALOG for the refining-natural gasoline-petrochemical industry.

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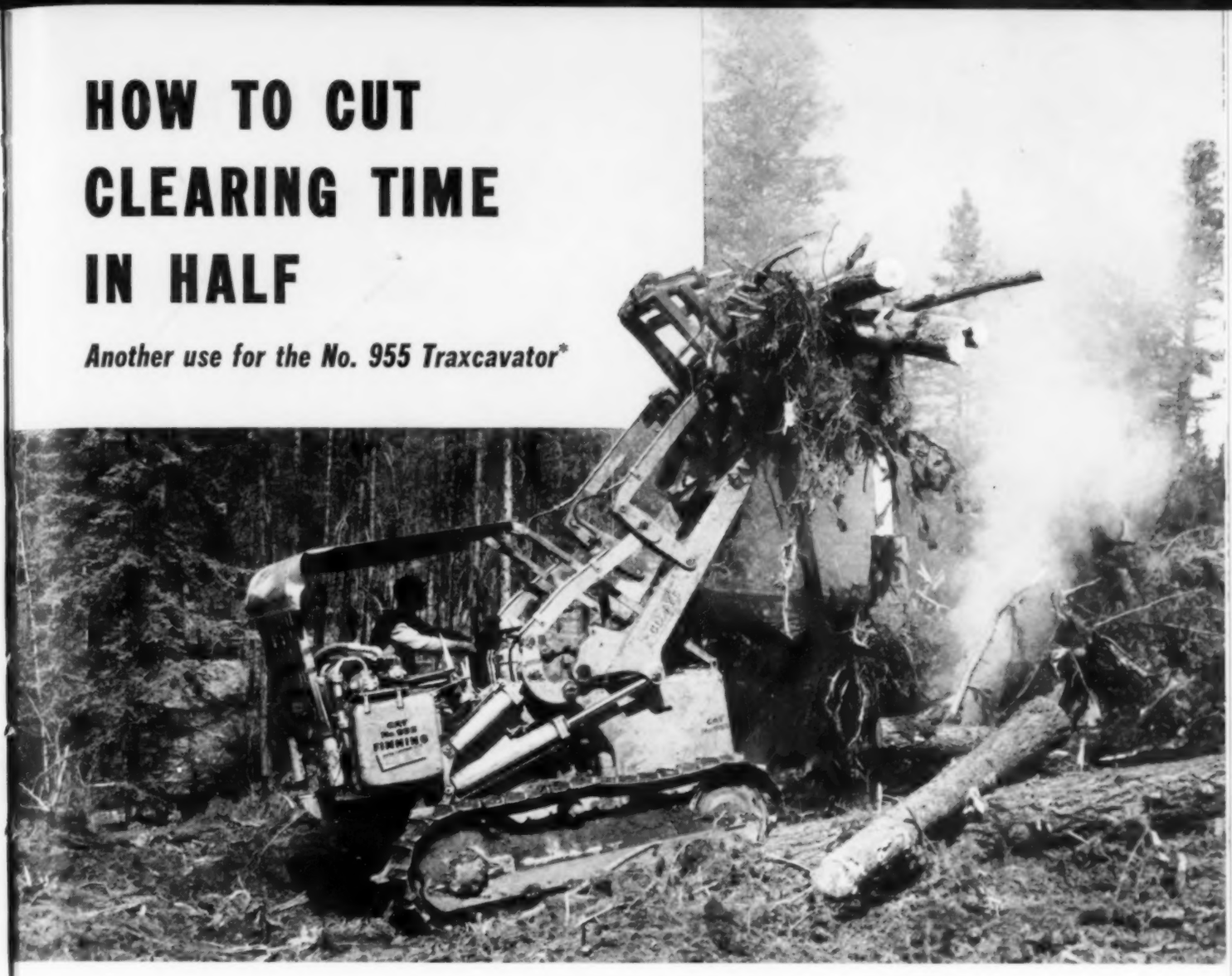
Indexed by Engineering Index and Industrial Arts Index

HOW TO CUT CLEARING TIME IN HALF

Another use for the No. 955 Traxcavator*



Conyes Construction Corp., San Pablo, Calif., is using six Caterpillar No. 955 Traxcavators to clear 210 miles of pipeline right-of-way in British Columbia. The company estimates that these Cat-built units *are cutting clearing time in half.* Here's how:

To cut a 60-foot-wide path through jack pine and fir, a D8 knocks down the trees. Everything over eight inches is salvaged by a crew. Then the No. 955s, equipped with alligator jaws operated with a hydraulic ram, pile the logs along the right-of-way and the remaining material on brush fires. The Traxcavators are even used to accelerate the fires. The units lift the top of the pile and use their blower-type engine fans to get a hot fire going quickly.

This method of clearing has enabled Conyes to average one-half to three-quarters of a mile per day in rough going—even working in 10 to 20 inches of snow!

The No. 955 is the newest Caterpillar-built equipment for pipeline spreads. Worked with alligator jaws, general purpose bucket, skeleton rock bucket, or bulldozer blades, this versatile unit enables you to pioneer roads, clear, backfill, build equipment sites and storage yards, and load trucks.

There are three sizes of Caterpillar-built Traxcavators—the No. 933, the No. 955 and the No. 977. They range in size from one-yard to 2¼-yard capacity, and, like all CAT* pipeline equipment, are designed to stay on the job.

Wherever the pipe takes you, you always are near fast, efficient Caterpillar service with factory parts that you can trust. So see your Caterpillar Dealer soon. He'll demonstrate these big, versatile machines on your job . . . at your convenience.

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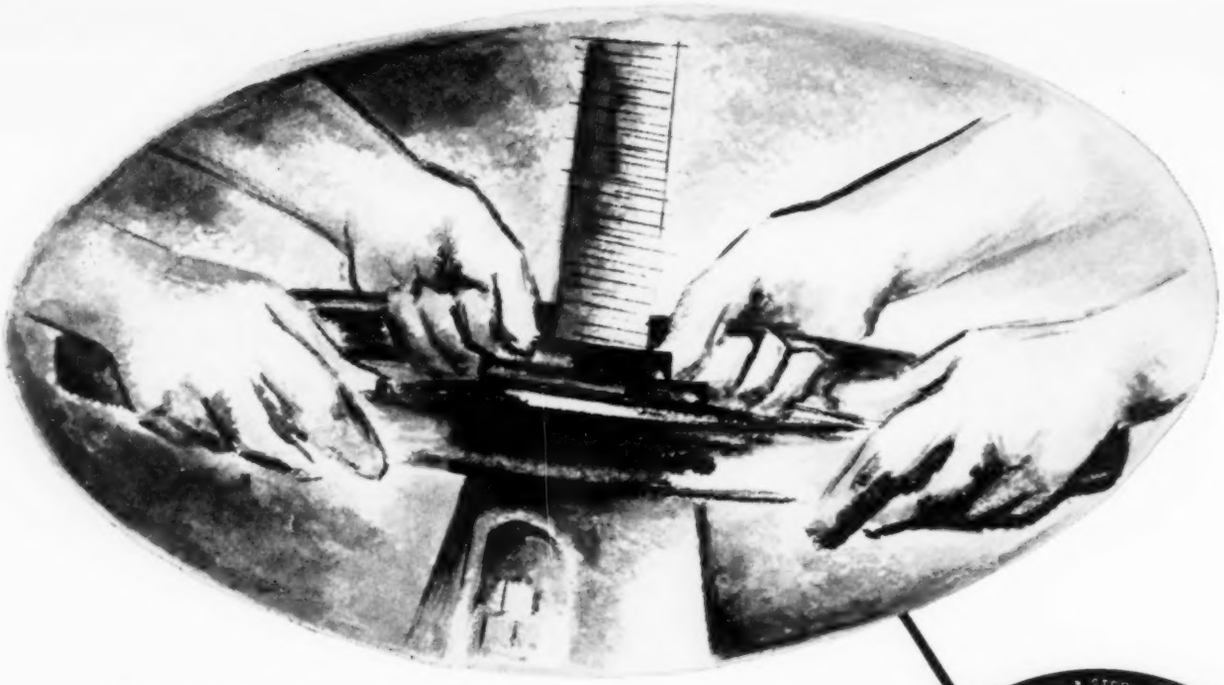
YOUR DEALER
WILL DEMONSTRATE**



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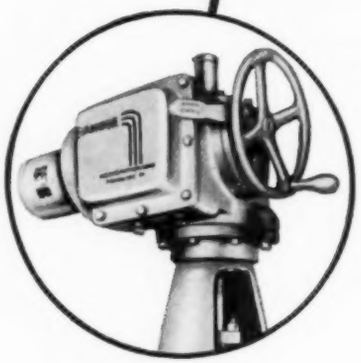

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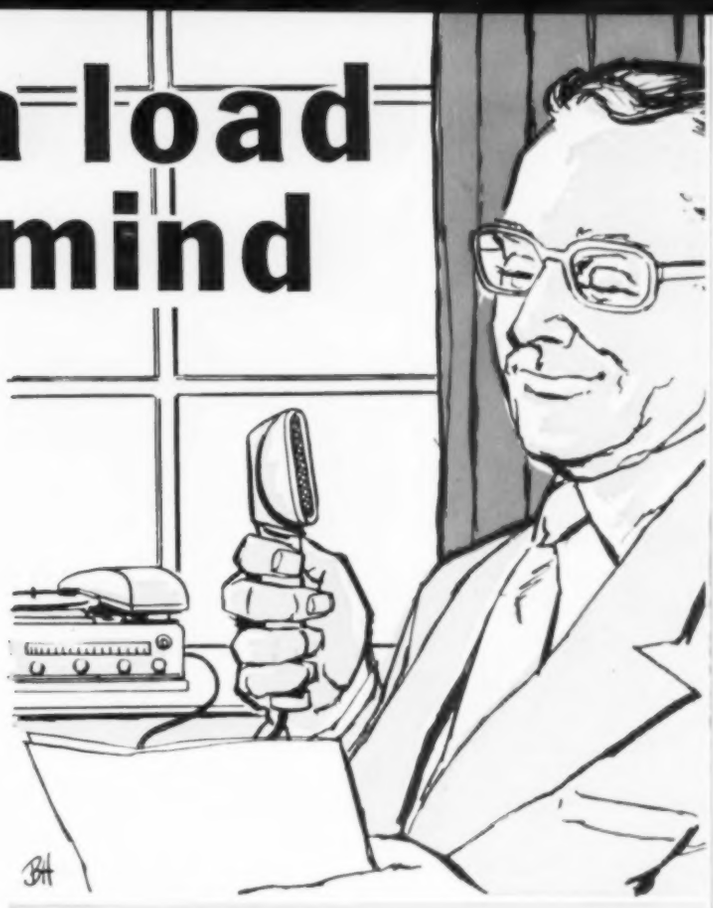

You're *sure*, when you specify GASO, of pumps that do what they're supposed to do — dependably, economically and for periods that extend far, far beyond accepted replacement intervals. You *know*, when you standardize on GASO Pumps, that you are following the lead of many of the world's best known, best managed pipe line operators. There's safety and assurance in such a choice. We're as close to you as our nearest distributor.

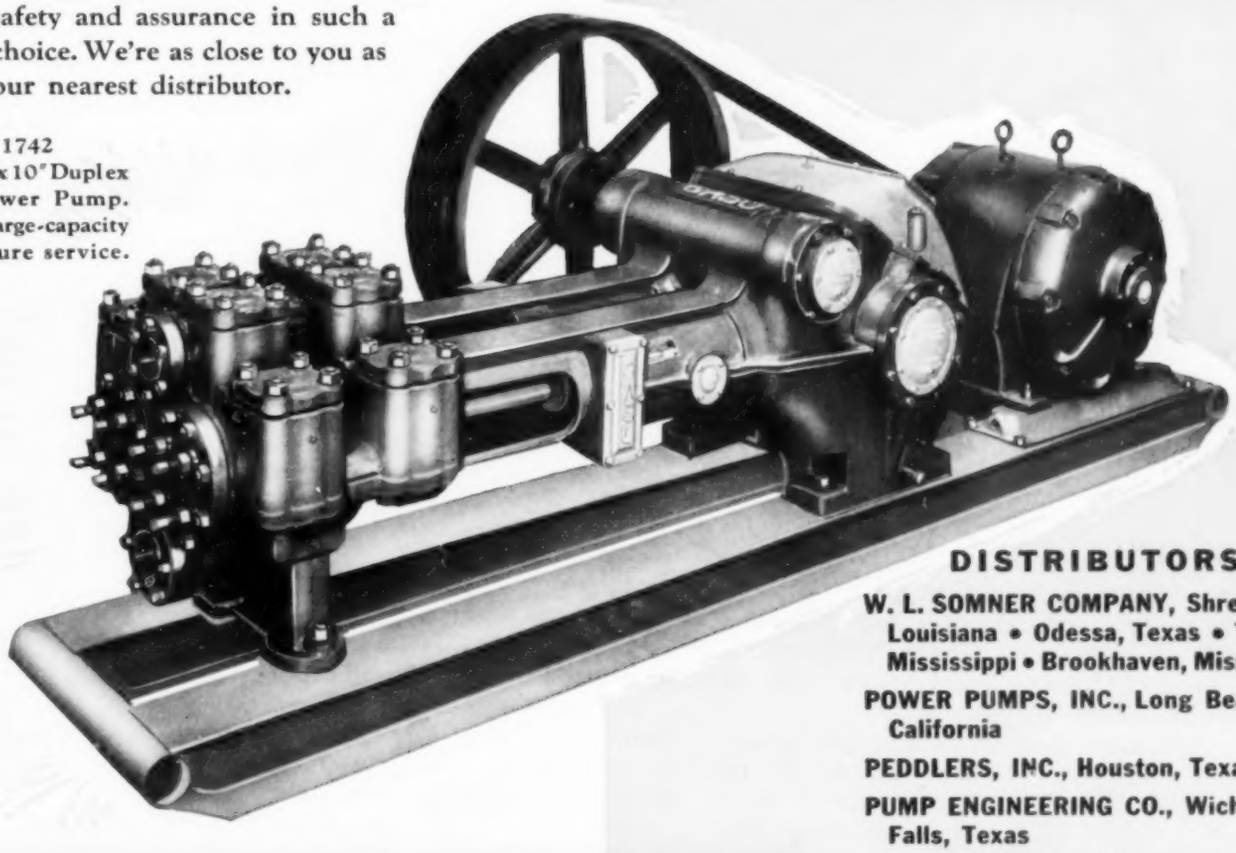

Fig. 1742
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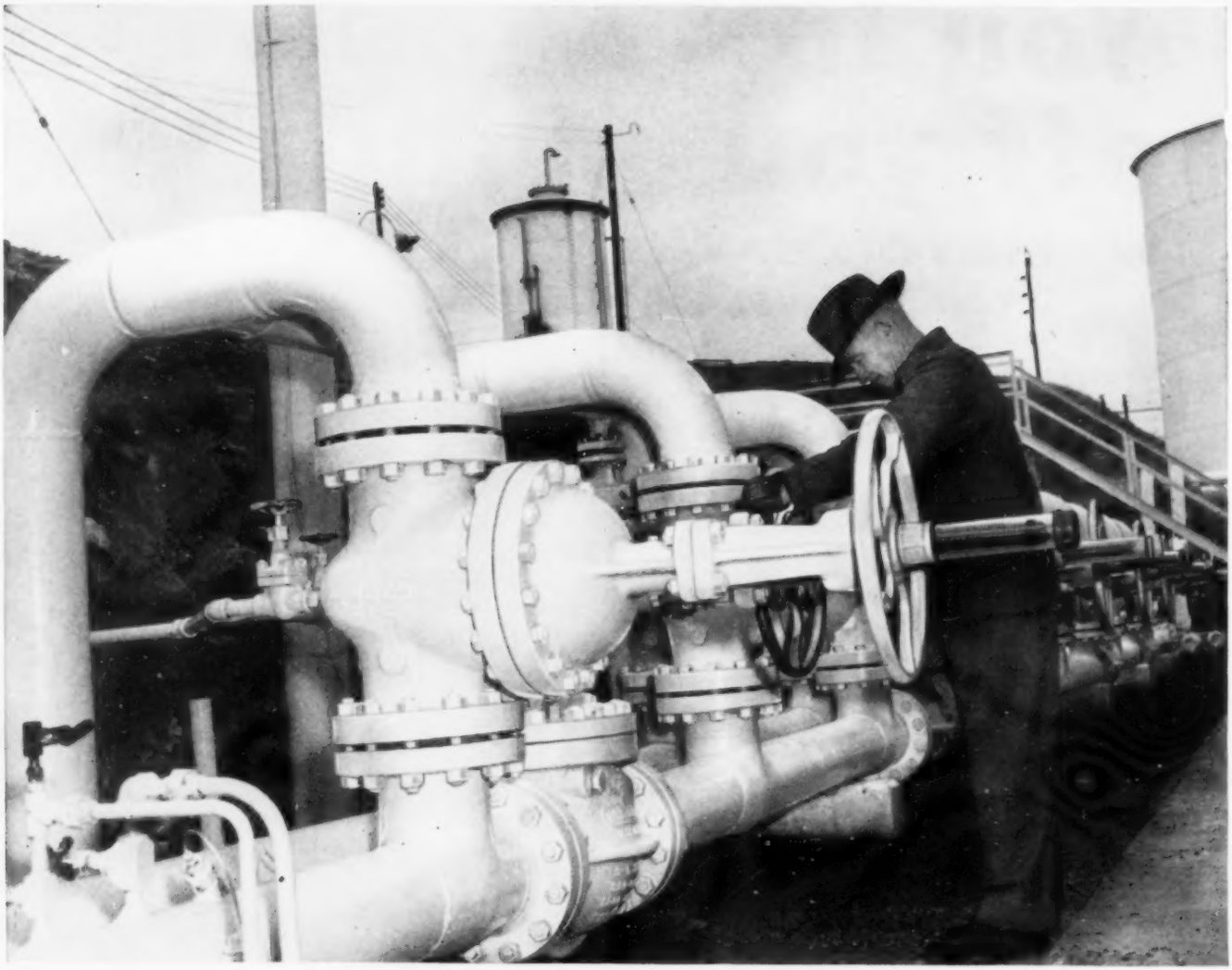


How one Crane valve gives double block protection at half the cost

Each of these Crane valves is doing the work of two.

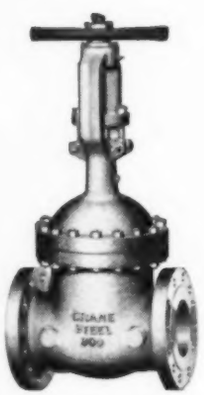
The valves are Crane 61 XU 400-pound steel gates modified with flexible wedge disc. They're installed in the pump manifold at the Borger main pump station of Phillips Pipeline Company's Borger-Chicago products line. This line was looped in 1951 to handle dissimilar products.

The header consists of 13 eight-inch valves, each with a telltale bleeder connection at the bottom. Depending on the product being handled, inlet pressure on the upstream side of a closed valve may be from 20 to 200 psi. Downstream pressure may go as high as 1100 psi. With the bleed valve open to atmosphere, there is *no leakage.*

Double-blocking is accomplished with a *single* valve fitted with a bleed line, cutting installation costs in half. Station personnel have half as many valves to operate. Product contamination is eliminated.

If you have a valve application where double valve, or valve and blind with bleeder, is indicated, why not get the facts on Crane flexible wedge disc gates?

Just ask your local Crane representative or write to the address below.



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* SIZES AND WEIGHTS AVAILABLE

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	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.134"	9.29
	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

Ease of installation and long uninterrupted service under high pressure convincingly demonstrate the quality of Acme-Newport electric weld line pipe. It bends and welds easily, lines up properly, is uniform in roundness and wall thickness. Such reliable performance is the result of constant control and inspection by Acme-Newport technicians during steel melting, rolling and pipe forming. These are properties demanded by customers and specified by API and ASTM. Acme-Newport continues to provide important tonnages of 4" and 6" electric weld line pipe* to this vital market.

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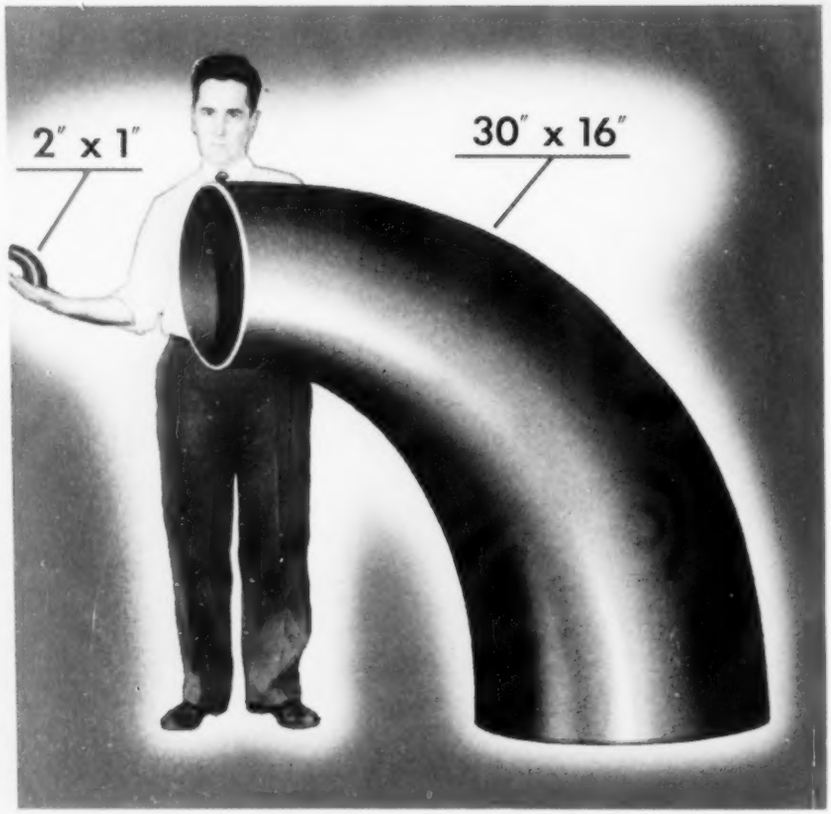

Your demand for Midwest Reducing Elbows has dictated our decision to make them STOCK items in all pipe sizes to 30″ OD and all reductions to one-half the nominal pipe size. We now have a modest stock of practically all sizes in standard and extra heavy weight, and this stock is being added to as rapidly as possible.

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Note the significant advantages of Midwest Reducing Elbows listed below. For further information, get in touch with the nearest Midwest Distributor or write us for Catalog 54.

✓ CHECK THESE ADVANTAGES OF MIDWEST REDUCING ELBOWS

- ✓ Save more than ⅓ of the welding required by standard elbows and reducers.
- ✓ Reduce turbulance and pressure drop because of gradual taper.
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- ✓ Improve appearance of piping.
- ✓ Available from stock in sizes to 30″ OD. (Heavy walls and alloys on special order.)

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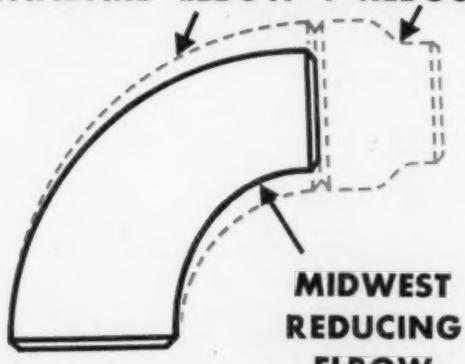


MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

ASHEVILLE (BOX 446, SKYLAND, N.C.)
BOSTON 27—426 FIRST ST.
CHICAGO 3—79 WEST MONROE ST.
CLEVELAND 14—616 ST. CLAIR AVE.
HOUSTON 2—1213 CAPITOL AVE.
LOS ANGELES 33—520 ANDERSON ST.
MIAMI 34—2103 LE JEUNE RD.
NEW YORK 7—50 CHURCH ST.
ONEIDA, N.Y.—282 NORTH MAIN ST.
SAN FRANCISCO 11—420 MARKET ST.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

766

Youngstown's "big 5"

MEAN ELECTRIC WELD LINE PIPE PROVEN AND READY FOR OIL AND GAS PRODUCING AREAS

Here are the "Big 5" reasons why Youngstown Electric Weld Line Pipe is your best buy:

1. It bends readily
2. Wall thickness is uniform
3. Line up characteristics are excellent
4. Weldability is outstanding
5. Long lengths save you time and trouble

In the process of producing Youngstown Electric Weld Line Pipe, every means is explored to assure uniform wall thickness. Uniformity of wall in the pipe begins with control of the skelp thickness produced on the rolling mill. The experience plus control in the rolling of the skelp by men who know steel makes this uniformity possible. Youngstown as an integrated producer has full control over the skelp rolling as well as the finished pipe production. To test the uniformity and quality, the pipe is then placed in a hydrostatic testing machine where internal pressure is applied. To obtain Electric Weld line pipe of uniform wall thickness—specify Youngstown Electric Weld line pipe for your next pipe line job.

Youngstown maintains sales and service offices throughout the oil and gas producing country—see your area representative soon.

Youngstown Electric Weld Line Pipe

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices - Youngstown 1, Ohio

District Sales Offices in Principal Cities

For more data on advertised products, use Readers' Service Cards, last page.

MEASURE

International Superior

FOR BIG-INCH

sideboom advantages

. . . . OR "SMALL-INCH" DUTY!

Your pipe-in-trench profits depend upon your pipe-handling equipment's performance. So it's just sound business to "take the measure" of world-proven International Superior sideboom spread-speeding advantages over anything else on the market!

Compare the TD-24, for example, to any other big tractor. Choose the gear-drive or torque-converter model with top or bottom hinged counter-weights. You'll discover time-saving, capacity-adding maneuverability and precision load control that no other boom unit delivers—uphill or down! Exclusive International TD-24 Planet Power steering lets you "feed" full-time live power to both tracks, straightaway or on the turns—to insure positive traction and no-jerk steering!

Try exclusive TD-24 finger-tip hydraulic braking and foot decelerator action—for positive pipe-carrying control over any terrain or footing—with exact regulation of tractor travel. And with minimum operator effort on grouped, reach-easy control levers, prove International TD-24's amazing inch-close accuracy of boom-action control.

Get convincing performance proof by calling your International Construction Equipment Distributor. He's prepared to lay it on the line and demonstrate, whenever you say. And compare new bonus-powered International Superior TD-18, TD-14, and TD-9 sidebooms to any other units in their size classes. See how any International Superior sideboom gives you a decisive extra margin of pipe-laying power for your equipment dollar.

Champ weight-lifter in its size class, this new International Superior TD-14 sideboom combines 32,950 lb lifting capacity with outstanding balance, plus capacity-adding maneuverability and load control.

Up to 57% grades were encountered on this mountainous section by a pipeliner moving through California, yet the TD-24 sidebooms pushed the 34-inch pipe up and over in rapid time. And you'll get extra traction-flotation to handle big loads on boggy ground, too, because TD-24 sidebooms put up to 18% less pounds-age psi on the tracks than other makes.

This new International Superior TD-9 sideboom and blade backfiller is No. 1 in its class as a profitable performer for feeder and small-pipe pipeliners, sewer contractors, and pipe stringers. Maximum lift: 17,000 lb at 4-ft overhang.

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

INTERNATIONAL® **SUPERIOR®**

International Harvester Co. **180 North Michigan Ave., Chicago 1, Ill.**

Whether it's repair or replacement...

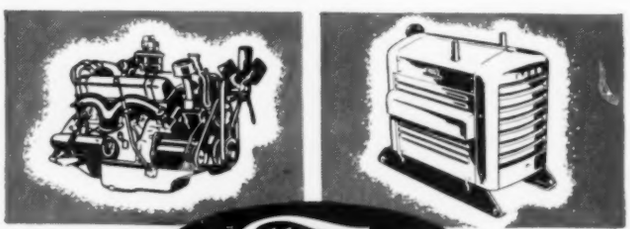
You'll find Ford Industrial Engine Service is available everywhere !

Know why so many industrial power users are swinging over to *Ford* power? One reason is service.

Ford power users *know* there's always a Ford Dealer nearby to give service when it's needed . . . to keep downtime at a minimum. And because Ford Dealers carry an inventory of the more commonly purchased engine parts, the Ford power user need never invest in a big parts inventory of his own.

Also, across the country, you'll find a network of newly established Ford Industrial Power Headquarters. Each is equipped to repower any type of equipment with dependable, low-cost Ford power.

It's the availability of service like this—wherever you are—that helps keep your operating costs *low*. If you are considering a new power unit or engine assembly—4-, 6- or 8-cylinder—see your Ford Industrial Products Dealer. He will be very happy to discuss your power requirements with you and make sure you get the one right power unit for *your* job. Write to the address below for further information.



Ford
INDUSTRIAL ENGINES
AND POWER UNITS

INDUSTRIAL ENGINE DEPARTMENT • FORD Division of FORD MOTOR COMPANY
P.O. Box 598, Dearborn, Michigan

YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED!

"THE HARDEST, BLOCKIEST ROCK WE EVER ENCOUNTERED", is how foreman described 805,000 cu. yds. of dense mica schist excavated along a 3.8-mile section of Connecticut Turnpike. Up to 30,000 lbs. of explosives were used in a week to shoot 30,000 yds. of rock. Thirteen big compressors, 9 of them Jaeger "600's", supported four 2½ yd. shovels.

How Jaeger "600's" sped Turnpike rock job

Excavating in lifts averaging 15′, Slattery Contracting Co., Inc., Maspeth, N. Y., worked fast to move 805,000 cu. yds. of hard rock on the Connecticut Turnpike. The largest cut, 58′, was taken down in two lifts of 30′ and 28′. Drilling was done in three patterns: 8′x8′, 7½′x7½′ and 6′x6′— a lot of footage. To assure plenty of reserve air for "hurry-up" production, a typical drilling spread teamed two Jaeger "600" Rotaries with three 375 cfm track-mounted drills, providing 400 cfm of 100-lb. air per drill. In other combinations, three Jaeger "600's" powered three and sometimes four 450 cfm track-drills.

Operating at their characteristic slower speed, nine efficient Jaeger "600's" maintained top drilling production for long hours, including double shifts. Full load speed of the Jaeger "600" is only 1650 rpm (100 to 150 rpm slower than other "600" compressors using the same Model 6-71 GM diesel engine), which reduces fuel consumption and engine piston travel and saves up to 9000 compressor revolutions per hour.

Other Jaeger rotaries (125, 250 and 365 cfm) give you this same slow-speed, high-efficiency performance — 1700 rpm at full load instead of 1800 to 1950. See your Jaeger distributor, or write for Catalog JCR-5.

JAEGER "365" SPEEDS WORK, TOO: Drives 6 Thor #25 heavy duty breakers with full 100-lb. air wallop to finish job in a hurry at a busy Philadelphia traffic intersection. No "old standard 315" compressor has the capacity to do such a fast job. Putting out 50 cfm more air, the Jaeger "365" operates at a fuel-saving, compressor-saving 1700 rpm at full load — 100 rpm slower than any "315" unit.

THE JAEGER MACHINE COMPANY

665 Dublin Avenue, Columbus 16, Ohio

PUMPS • CONCRETE MIXERS • SPREADERS • FINISHERS • TRUCK MIXERS

Use **Humble Industrial Engine Lubricants** for Smooth Operating Efficiency and Longer Engine Life

At your request, one of Humble's trained lubrication engineers will make a study of your lubrication problems and give you specific recommendations for their solution. This service is without cost or obligation.

By using the correct Humble lubricants, you protect your costly equipment—reducing friction wear and increasing efficiency and engine life. Humble has a top-quality lubricant designed for your industrial engine, regardless of type or make.

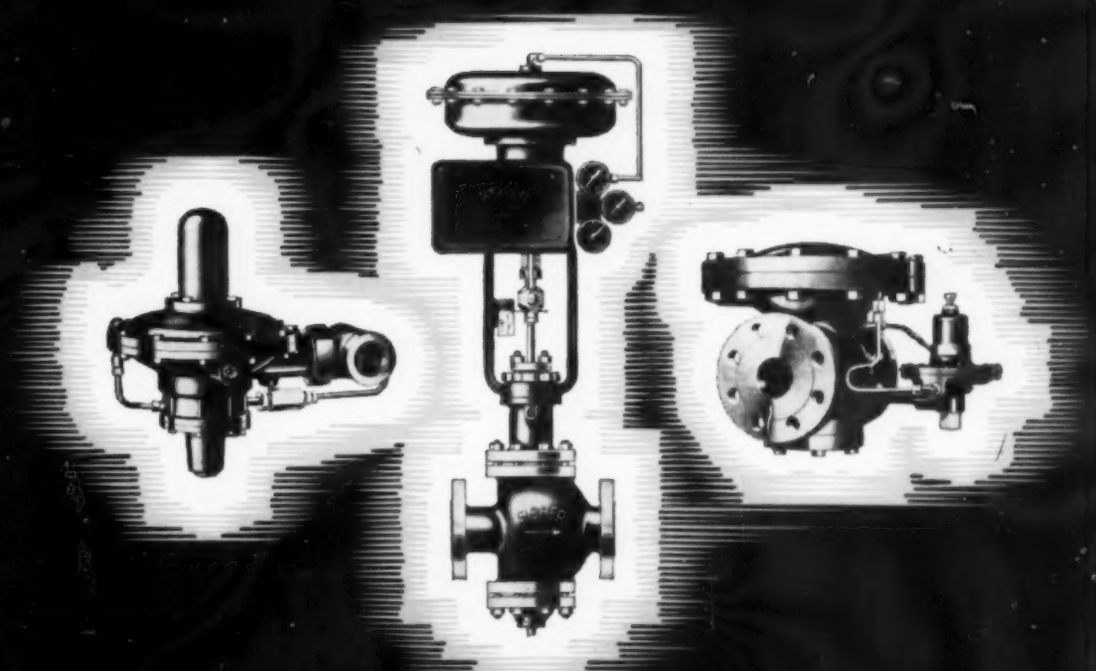
For complete information on Humble industrial engine lubricants see your Humble salesman, or write or phone:

HUMBLE OIL & REFINING COMPANY

HUMBLE

Technical Service
Sales Department
Humble Oil & Refining Company
P. O. Box 2180
Houston 1, Texas

the tough Control Valve jobs go to



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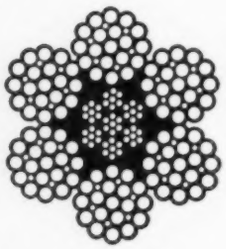
WICKWIRE

DOUBLE GRAY



WIRE ROPE

An extra improved plow steel wire rope with independent wire rope core, Double Gray gives you a rated breaking strength that's 15% greater than the catalog breaking strength of ropes of the same size and type made from improved plow steel.

Double Gray is *not* a new rope . . . *not* a rope that's offered to you on an "experimental" basis. Instead, it's been thoroughly tested in both the field and the laboratory. This means that you can now get extra high strength ropes with greater abrasion and crushing resistance . . . *plus* the knowledge that you're using a *safe* wire rope that's made by a company long known for its top-quality products.

Contact your nearby Wickwire Distributor or CF&I sales office for complete details and recommendations for your particular applications.

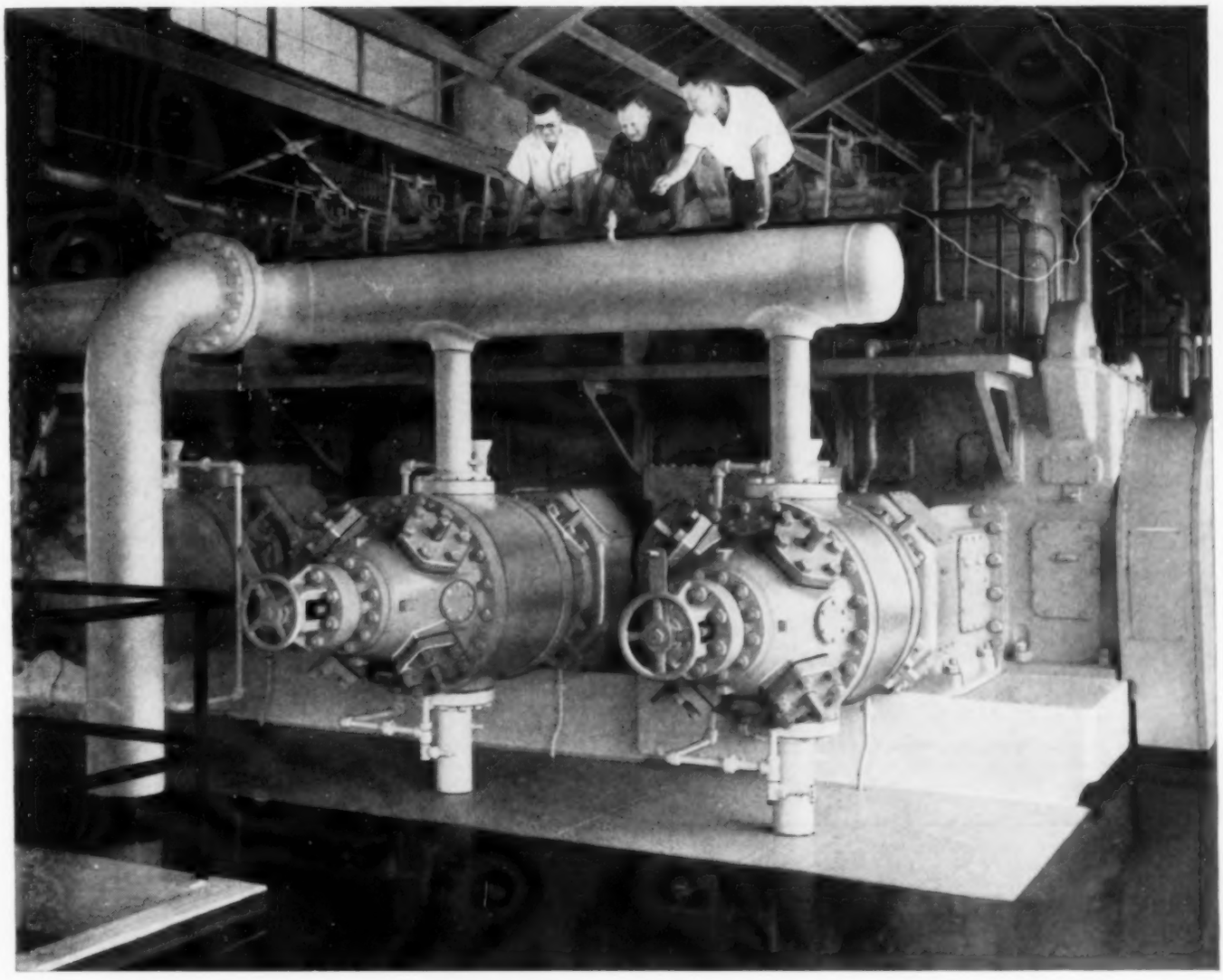
PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

CF&I

THE COLORADO FUEL AND IRON CORPORATION—Denver • Houston • Odessa (Tex.) • Phoenix • Salt Lake City • Tulsa
PACIFIC COAST DIVISION—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.)
New Orleans • New York • Philadelphia

LOOK FOR THE YELLOW TRIANGLE

5078



Richard N. Rogers, Results Engineer (left), W. C. Drienhofer, Station Superintendent, and R. A. Cuyler, Jr., Gulf Sales Engineer, inspect one of the 31 units lubricated by Gulf Security since 1944.

At Tennessee Gas Transmission Company's Middleton Station . . .

Not a ring change in 26,800 hours with

GULF SECURITY OIL

31 gas engine compressor units have been running smoothly at the Middleton Station with Gulf Security Oil since 1944. The records show 26,800 hours operation without a single ring change. And after 85,000 hours, Security in the crankcase was still in excellent condition.

Here for 13 years Gulf Security has lived up to its name—security against operating troubles and high maintenance costs. Gas engine compressor units lubricated with Gulf Security are consistently free of heavy port and ring belt deposits. Wear is negligible—in fact, ring and liner life in both power and compressor cylinders is well above average. Bearings last longer, too.

When you use a Gulf product you get an extra dividend—the free services of an experienced Gulf engineer. He's always "on call" to assist you with any problem involving lubricants, fuels, or any other petroleum product. Write, wire or phone your nearest Gulf office.

GULF

GULF OIL CORPORATION

1822 Gulf Building
Pittsburgh 30, Pa.

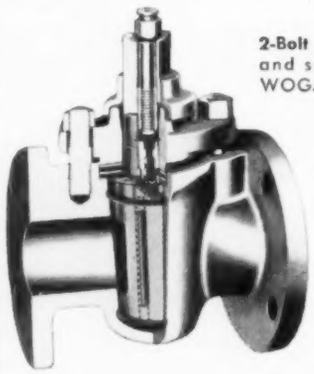
For more data on advertised products, use Readers' Service Cards, last page.

Cut flow control costs... standardize on...

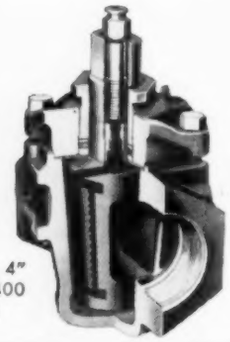
THE WORLD'S MOST COMPLETE

LUBRICANTS and

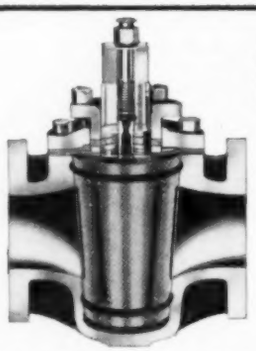
VALVES



2-Bolt Cover Type Valve in 4" and smaller sizes for 175-lb WOG. *Semi-Steel*

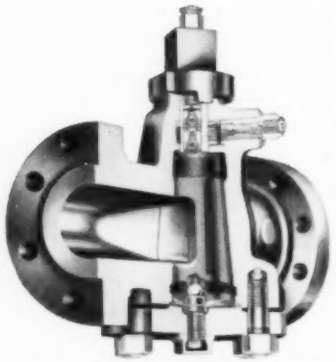


Screwed Gland Type Valve in 4" and smaller sizes for 200, 400 and 500-lb WOG. *Semi-Steel*



Bolted Gland Type Valve in 4" to 36" for 200 through 800-lb WOG Semi-Steel and ASA 150-lb and 300-lb Carbon Steel.

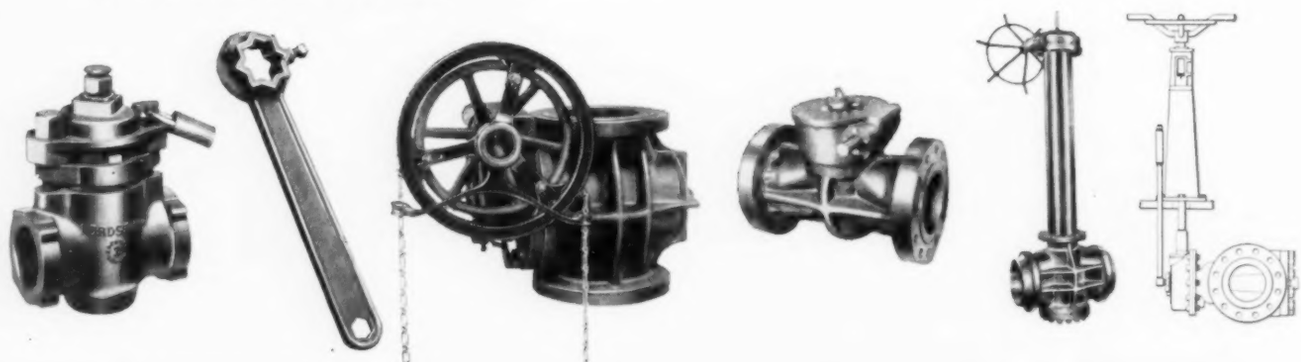
Hypreseal Valve—Bolted Bottom Cover Type. ½" to 30 by 34" for ASA 150-lb through 1500-lb Carbon Steel (with rectangular opening). API 2000-lb and 3000-lb WOG Alloy Steel Rectangular Opening. API 2000 and 3000-lb WOG Alloy Steel (with round opening).



LUBRICANTS

PROPER VALVE LUBRICATION means longer valve life and better performance at lower cost. Rockwell is the world's oldest and most experienced manufacturer of lubricated plug valve lubricants. To assure perfect performance, a *complete line* of lubricants has been developed and field proved. For convenience, they are available in stick, tube and bulk forms. The Rockwell High Pressure Booster Type Hand Gun and Rockwell High Pressure Booster Type Bucket Gun make the lubrication of even a great number of valves a job that takes only minutes.

ACCESSORIES

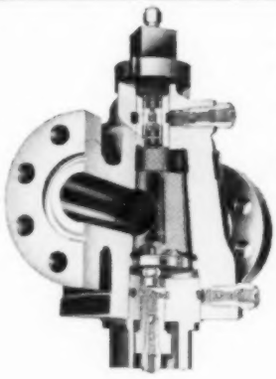


GREATER DESIGN AND INSTALLATION FREEDOM are the "extras" you get when you specify Rockwell-Nordstrom valves and accessories. No matter what your operating requirements or problems, you can select from a *complete* line of valve accessories that assure easier, safer, more efficient operation.

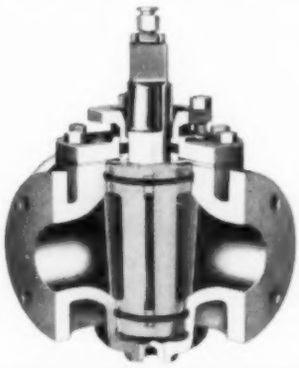
While only a few of the valve accessories are shown above, you can learn about the complete selection by talking with your Rockwell-Nordstrom sales engineer or writing directly to: Rockwell Manufacturing Company, 400 N. Lexington Avenue, Pittsburgh 8, Pennsylvania.

LINE OF LUBRICATED PLUG VALVES,

ACCESSORIES



Hypreseal Valve—Screwed Bottom Cover Type. ½" to 8" for 7500-lb WOG Alloy Steel (rectangular opening). ASA 2500-lb Carbon Steel (rectangular opening). API 5000-lb and 10,000-lb WOG (rectangular opening) and API 5000-lb and 10,000-lb WOG (round opening).



Multiport Valve Type. Available in Gland type and Hypreseal type in WOG pressures to 400 lb and ASA pressures to 1500-lb. Sizes from ½" to 24".

ALL THESE ADVANTAGES
In *Every* Rockwell-Nordstrom Valve.

LEAKPROOF: Lubricant sealing is a *double* seal against leakage.

LONG-LIFE: Lubricant prevents metal-to-metal wearing friction.

LOW-COST: Lubrication is preventive maintenance.

DEPENDABLE: Hydraulic lubricant action jacks plug for instant operation.

QUARTER-TURN OPERATION: 90° turn for *full* positive shut-off.

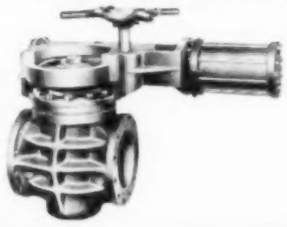
SMOOTH PASSAGE: Straight-through flow without crevices . . . minimum pressure drop.

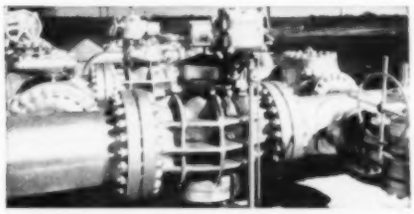
UNEXPOSED SEATS: Corrosion and erosion eliminated in vital seat areas.

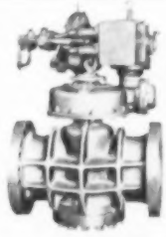
ADJUST, LUBRICATE UNDER PRESSURE: Never down time for routine servicing.

No other valve—at any price—can offer the performance and longer life at lower cost of Rockwell-Nordstrom valves.

POWER OPERATORS



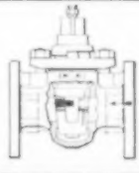




AUTOMATIC VALVE OPERATION is more dependable and economical when you specify Rockwell-Nordstrom valves. They are far superior to ordinary valves for power operation because *lubrication* reduces operating torque—smaller, less costly actuators can be used. And since there are no forced, wedged seats to be set, the actuator has only to move the lubricated plug through 90°.

Typical electric, pneumatic and cylinder operators shown above represent only three of the more than fourteen power operation arrangements available.

VALVES WITH SPECIAL FEATURES



NO MATTER WHAT YOUR NEEDS, there is a Rockwell-Nordstrom valve that will do the job better, longer and at lower cost. A few of the Rockwell-Nordstrom valves with special features are shown above.

Special metal valves are available in stainless-steel, bronze and other corrosion resisting alloys for even the toughest services. Valves with *hard faced plugs and bodies* combine the economy of semi-steel with hard facing for utmost corrosion and wear resistance. *Steam jacketed valves* for precise product temperature control. *By-pass relief valves* prevent pressure build-up that imposes dangerous stress on ordinary valves and fittings. *Gas safety control (Factory Mutual) valves* for positive control against explosion in multi-burner gas-fired furnaces, ovens and driers.

* * * *

Rockwell-Nordstrom valves and accessories are available at leading oil field and industrial distributors everywhere. For full information write: Rockwell Manufacturing Company, 400 N. Lexington Avenue, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom **VALVES**

Lubricant Sealed For Positive Shut-off

Announcing

THE NEW PIPE LINE COMPOSITE CATALOG

The publishers of PIPE LINE INDUSTRY take pleasure in announcing a new, specialized catalog service for men engaged in pipe line operations, maintenance and construction. The new publication will be a composite file of catalog data from companies selling their products or services to:

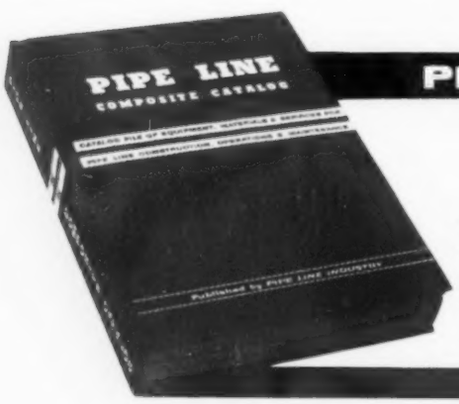
- Crude Pipe Line Companies
- Products Pipe Line Companies
- Gas Transmission Companies
- Pipe Line Contractors
- Engineering-Design-Construction Firms

The PIPE LINE COMPOSITE CATALOG will be a case bound book, indexed and cross-indexed by company and by product or service. It will contain the complete or condensed catalogs of manufacturers and service companies serving the pipe line market.

ENTHUSIASTIC INDUSTRY ACCEPTANCE

When the plan to publish this new PIPE LINE COMPOSITE CATALOG was presented to 3,500 pipe line men, they responded with overwhelming approval of the idea. More than 97% of the men answering the survey said they would prefer such a catalog, will use it and want a copy when published.

For further information concerning the new PIPE LINE COMPOSITE CATALOG, contact any of the Gulf Publishing Company offices listed below.



PIPE LINE COMPOSITE CATALOG

Specialized **PETROLEUM** *Publications*

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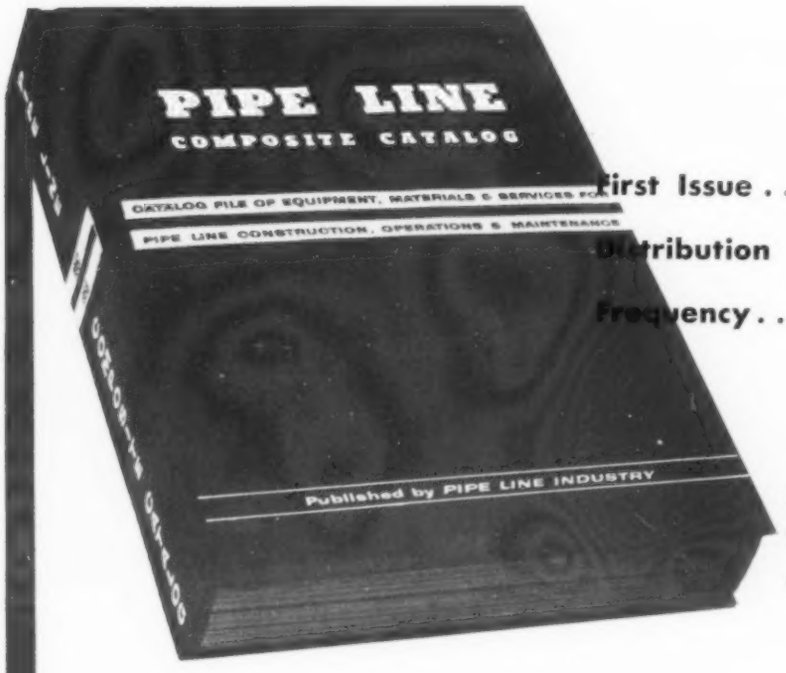
- **Chicago (4),** 332 S. Michigan Avenue, WAbash 2-9330
- **Cleveland (15),** 1010 Euclid Avenue, MAin 1-3295
- **Tulsa (3),** 916 Enterprise Bldg., CHerry 2-9211
- **Dallas (1),** 518 Santa Fe Bldg., RIverside 7-7344
- **Los Angeles,** W. W. Wilson Building, Huntington Park, LUdlow 7-1219

A New Service FOR BOTH

BUYERS AND SELLERS OF PIPE LINE EQUIPMENT


PIPE LINE
COMPOSITE CATALOG
CATALOG FILE OF EQUIPMENT, MATERIALS & SERVICES FOR
PIPE LINE CONSTRUCTION, OPERATIONS & MAINTENANCE
Published by PIPE LINE INDUSTRY

First Issue . . . . . July, 1957

Distribution 4,000

Frequency . . . . . Every 18 Months

Another Gulf Publishing Company service for the oil and gas industry.

IF YOU BUY EQUIPMENT OR SERVICES

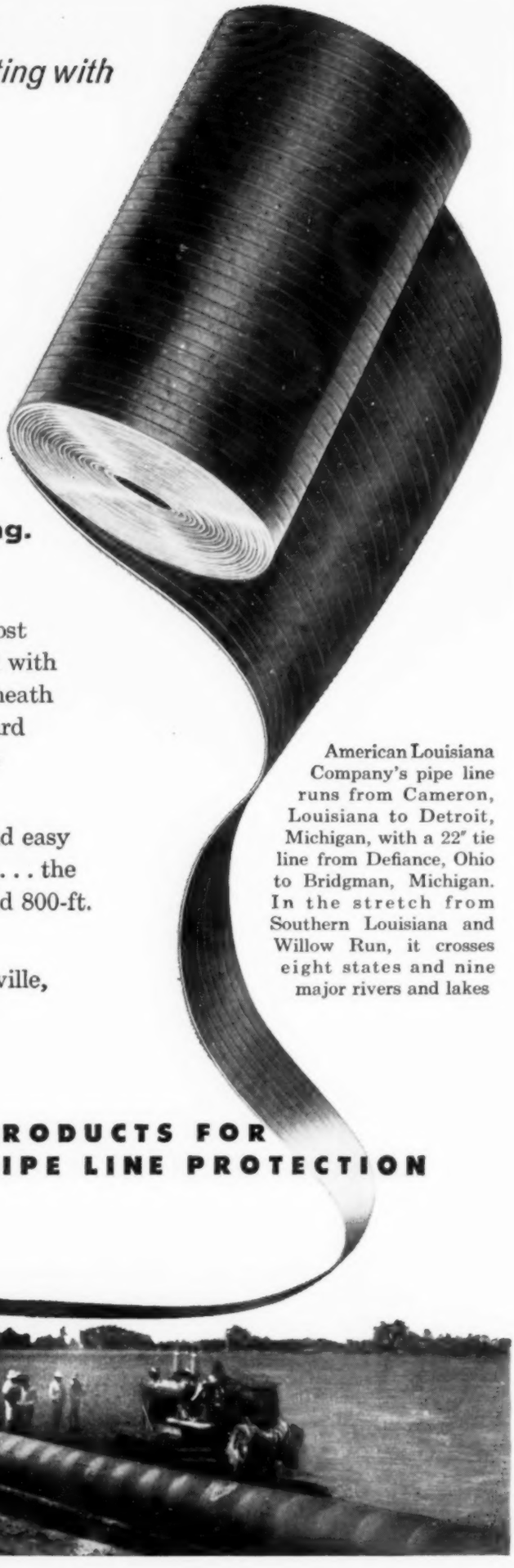
Be sure to watch for the first issue of the new PIPE LINE COMPOSITE CATALOG. Ask your supervisor to check with your company management to see if your name is among those which your company has submitted to us to receive a personal copy of the new PIPE LINE COMPOSITE CATALOG.

Full of job-help material. The Catalog will contain specifications and engineering data actually supplied by the manufacturers, service companies and suppliers serving the industry. For fast, convenient, comprehensive help in your job, make sure a copy is available to you. It will make your buying or specifying job easier.

American Louisiana Pipe Line protects approximately 600 miles of its pipe coating with

Johns-Manville Transhield®

Asbestos Pipe Line Felt



Permits high-speed wrapping... assures effective protection for coating.

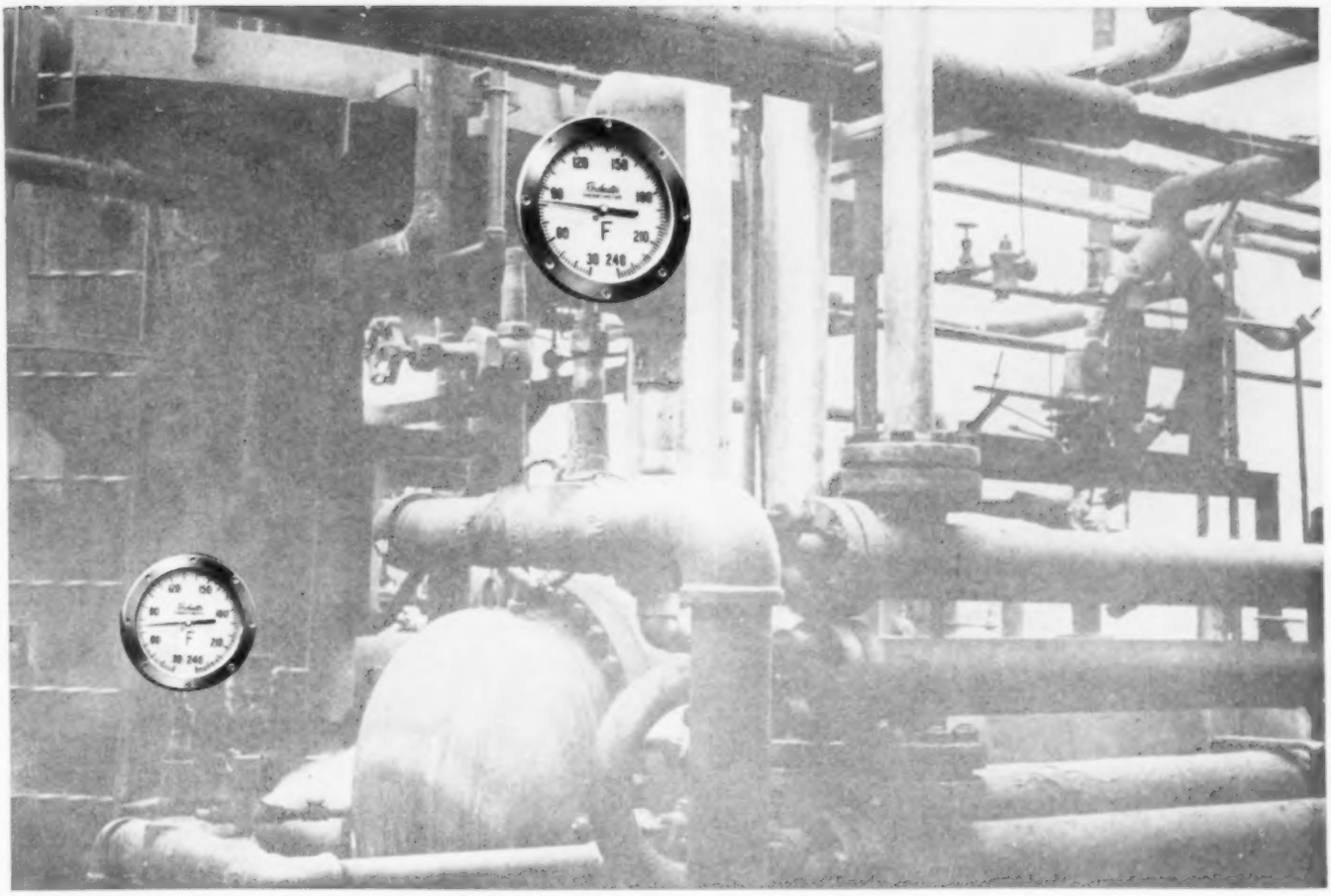
Transhield gives high value for a reasonable cost . . . made of tough, long-life asbestos reinforced with parallel glass yarns . . . it forms a continuous sheath between the enamel coating and the soil to guard against soil stress and give long life to the pipe line coating.

Contractors like Transhield's light weight and easy application . . . it speeds up coating operations . . . the high tear strength (a knife is used to cut it) and 800-ft. rolls lower construction costs.

For further information write to Johns-Manville, Box 14, New York 16, N.Y.; in Canada, 565 Lakeshore Road East, Port Credit, Ontario.

American Louisiana Company's pipe line runs from Cameron, Louisiana to Detroit, Michigan, with a 22" tie line from Defiance, Ohio to Bridgman, Michigan. In the stretch from Southern Louisiana and Willow Run, it crosses eight states and nine major rivers and lakes

JOHNS MANVILLE JM PRODUCTS **Johns-Manville** PRODUCTS FOR PIPE LINE PROTECTION



There's an RMC thermometer for almost every industrial requirement

Dial sizes from 1″ to 5″, stem lengths from 2½″ to 70″, scale ranges from −150° F to +1000° F. These figures represent *only* Rochester Manufacturing Company's *standard* thermometer specification limits. There is practically no limit to what RMC can do in the way of *special* thermometer applications.

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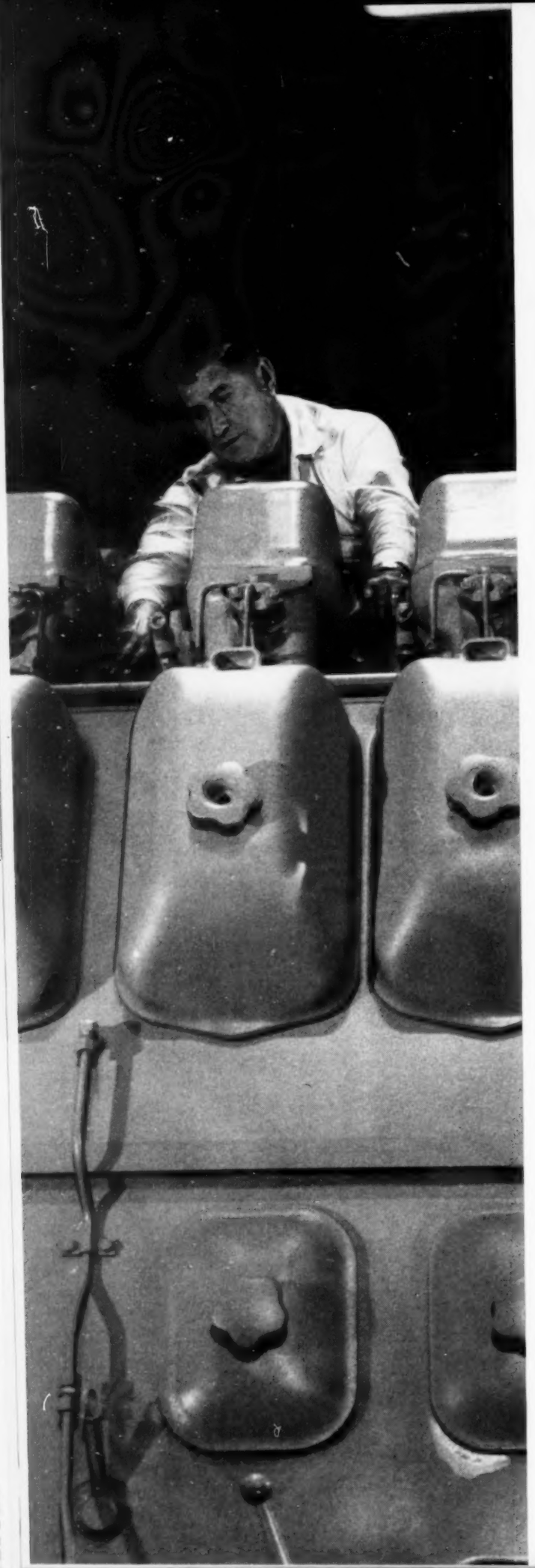

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The ALCO 251 diesel is modern for good reasons. The first: To save you money. ALCO engineers designed this engine with up-to-date materials, lowering maintenance and slashing weight. Through modern turbocharging and fuel injection they endowed it with more horsepower — reliable horsepower — to drive pumps, compressors, generators, shafts efficiently and economically.

All this means that you can install ALCO engines inexpensively. Heavy costly foundations, grouting, are unnecessary. It means, too, that maintenance costs are lower because modern materials wear longer, and the 251 diesel's design lets your maintenance people get into the engine faster. Replacement parts are readily available from ALCO's six regional warehouses.

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Condensed Specifications* for ALCO 251 Diesels

No. Cyl.	Bore and Stroke (in.)	RPM Range	BHP Range	Approx. Wt Dry (lb)
6	9 x 10½	350-1000	550-900	22,100
12	9 x 10½	350-1000	1100-1800	32,650
16	9 x 10½	350-1000	1470-2400	42,000

*DEMA standards

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Wheaton T-1700 Gauge Hatch

Get Wheaton *precision* in GAUGE HATCHES

With Wheaton Gauge Hatches you get vapor-tight seating — a dependable way to reduce evaporation losses in cone roof, and low-pressurized storage tanks.

Positive tightness is assured by a resilient seal in a cast iron cover, and a non-corrosive bronze seat in the steel base. The cover closes automatically, and the impact of sudden closing is cushioned by the resilient cover seal. Units are available in T-1705 lock-down and T-1710 hand operated types, as well as T-1720S all-aluminum construction.

Get Wheaton *precision* in gauge hatches and other tank fittings — backed by 65 years of experience in the development of petroleum and chemical equipment. Send for Catalog No. 66, which illustrates and describes the complete line of Wheaton Tank Fittings.

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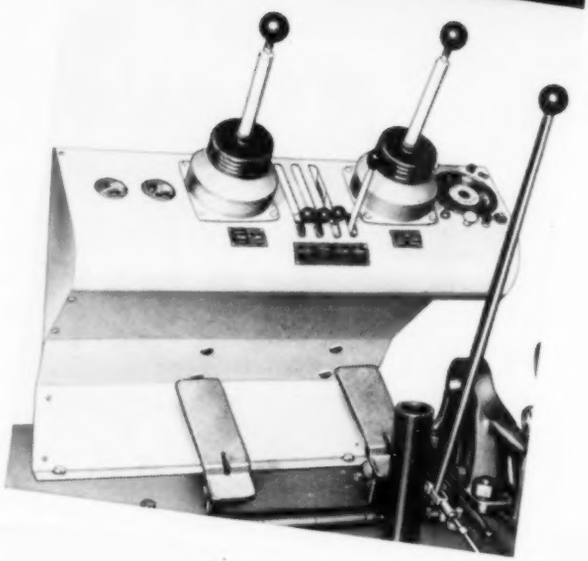
Operators never had it so easy as at the . . .

controls of a LORAIN-26

Try the 2-Lever, "Joy-Stick" Hydraulic Power Controls available on a Lorain-26 Pipeliner and you will never want to go back to the old 3 and 4 lever controls of other models. For here is the newest, simplest, most responsive and effortless control in a pipeline excavator today. Only 2 hand levers operate hydraulically all 5 clutches which control direction and transmission of power for all turntable operations. And, with the 2-lever, "Joy-Stick" design, the operator "meters" the power to clutches at any rate desired — a little or a lot — slowly or rapidly — and still retains the normal "feel" of all operations. Result is faster, smoother, easier operation — fewer motions, less operator fatigue — higher production.



Ask your Thew-Lorain Distributor for all the new ideas in the Lorain-26 Pipeliner . . . the 2-lever, "Joy-Stick" feature . . . the Torque Converter that automatically matches power to digging demands . . . a heavy-duty, sturdy crawler with enclosed, protected tread lock . . . hydraulic power operation of all crawler functions . . . sealed idler rollers on anti-friction bearings available . . . a longer, heavier Hoe Boom that digs harder materials — and digs deeper . . . these are a few. Be sure to get the Lorain-26 "Pipeliner" story.

THE THEW SHOVEL CO., LORAIN, OHIO

THEW LORAIN®

Tuffy® Sling Bulletin

Reporting the Outstanding Performance of Union Wire Rope's Machine-Braided Wire Fabric Slings.

Tuffy's a Hard One to Kink... and a Breeze to Unkink!

You'll find it next to impossible to kink a Tuffy sling by hand. If you succeed, even with the aid of a vise, see how easily the braided fabric can be straightened out with no material damage.

Tuffy's Streamlined Ferrule is Pressed On Over Tucked Eye-Splices for 100% Strength of Sling

Tremendous machine pressure swages Tuffy's smooth-edged metal ferrule around the tuck splice. Metal virtually "flows" into the braided fabric interstices. This compressive treatment gives the eye of the sling 100% of the strength of the wire fabric. Eyes *stay* spliced!

Tuffy Hoist Line Delivers Big Extras of Dependability and Long Wear

Tuffy Hoist Line is a special rope construction for hoisting on all types of over-head, stiff leg and mobile cranes, derricks and clamshells. Combines extra flexibility and toughness to absorb load shocks. Tuffy slings and hoist lines work with hand-and-glove harmony to cut hoisting costs and downtime in every kind of materials handling.

Your Tuffy Distributor will help you give Tuffy Slings and Hoist Lines "the works" test on the job you choose

FREE! Send Coupon for Handbook now

For Canada, Safety Supply Co., Toronto

Give Tuffy "the Works;" then Take a Long Look at the Increase in Sling Service You Get Per Dollar

Tuffy asks no coddling. Put Tuffy slings on your toughest jobs. Give them the "full treatment" of hard service. They'll take it, and then some. And you'll be ahead in dollars saved by Tuffy's longer wear and faster handling. The secret is the patented machine-braided construction of Tuffy slings. It produces a combination of extra flexibility and extra toughness never possible with ordinary wire rope — and a big step ahead of costly hand-braided slings. This 9-part Tuffy fabric is precision-braided by machine in a way that eliminates the inequalities of hand-braiding. Tuffy Slings have no cores. Even when one of the 9 parts is cut or broken, it does not result in stranding.

Watch Your Men Sling Loads Faster, Easier, with Greater Safety

Tuffy fabric and Tuffy's pressed-on ferrule team up to speed up sling work. The high flexibility and kink resistance of Tuffy slings make for smooth handling, and the Tuffy ferrule makes a pulled-out splice virtually a thing of the past. Because the ends of the ferrule are swaged flush with the machine-braided strands, there are no projections to snag on loads or injure hands. No wonder handlers work faster, safer, with Tuffy slings.

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Specialists in high carbon wire, wire rope, braided wire fabric, stress relieved wire and strand

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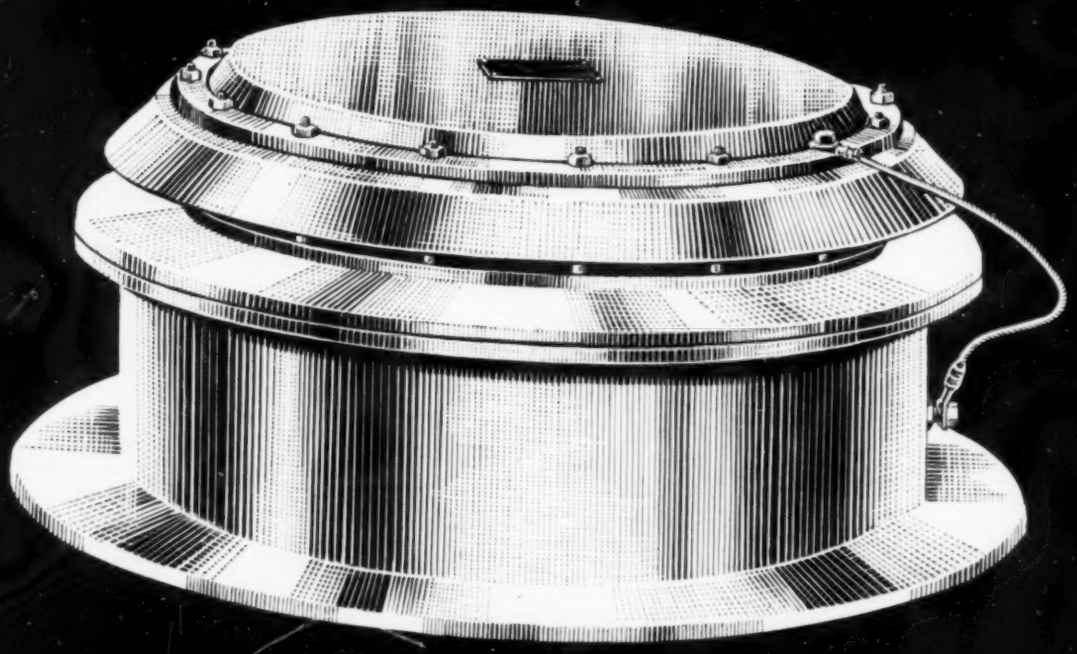
20" Emergency Pressure and Vacuum Relief



Illustrated here is the new S. & J. Model ST-5455 PV Emergency Vent, designed to cope with excessive internal pressure and vacuum conditions in above ground tanks of unlimited size.

Adapted to the standard 20" A.P.I. manhole, this emergency vent is sturdily constructed to resist mis-shaping by manhole flanges not perfectly flat. Entire cover can be lifted off base in a matter of seconds, providing clear and unobstructed passage through the 20" opening. No gaskets to replace—no unbolting is involved—removal speed is paramount.

Cover serves as pallet, and under severe conditions may rise out of manhole completely. A safety cable fastens cover to the base. Standard loading for pressure relief 1 oz./sq. in. and ¾" water for vacuum relief. Interested engineers are invited to request a copy of Engineering Data Sheet.

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Excellent weldability, plus uniformity in diameter, concentricity and end finish, make Kaiser Steel Line Pipe easy to weld in the field.

This means more pipe can be laid per day.

Next time you are ordering line pipe, specify Kaiser Steel Line Pipe.

Rely on Kaiser Steel quality and service to add dollars to your operating profits.

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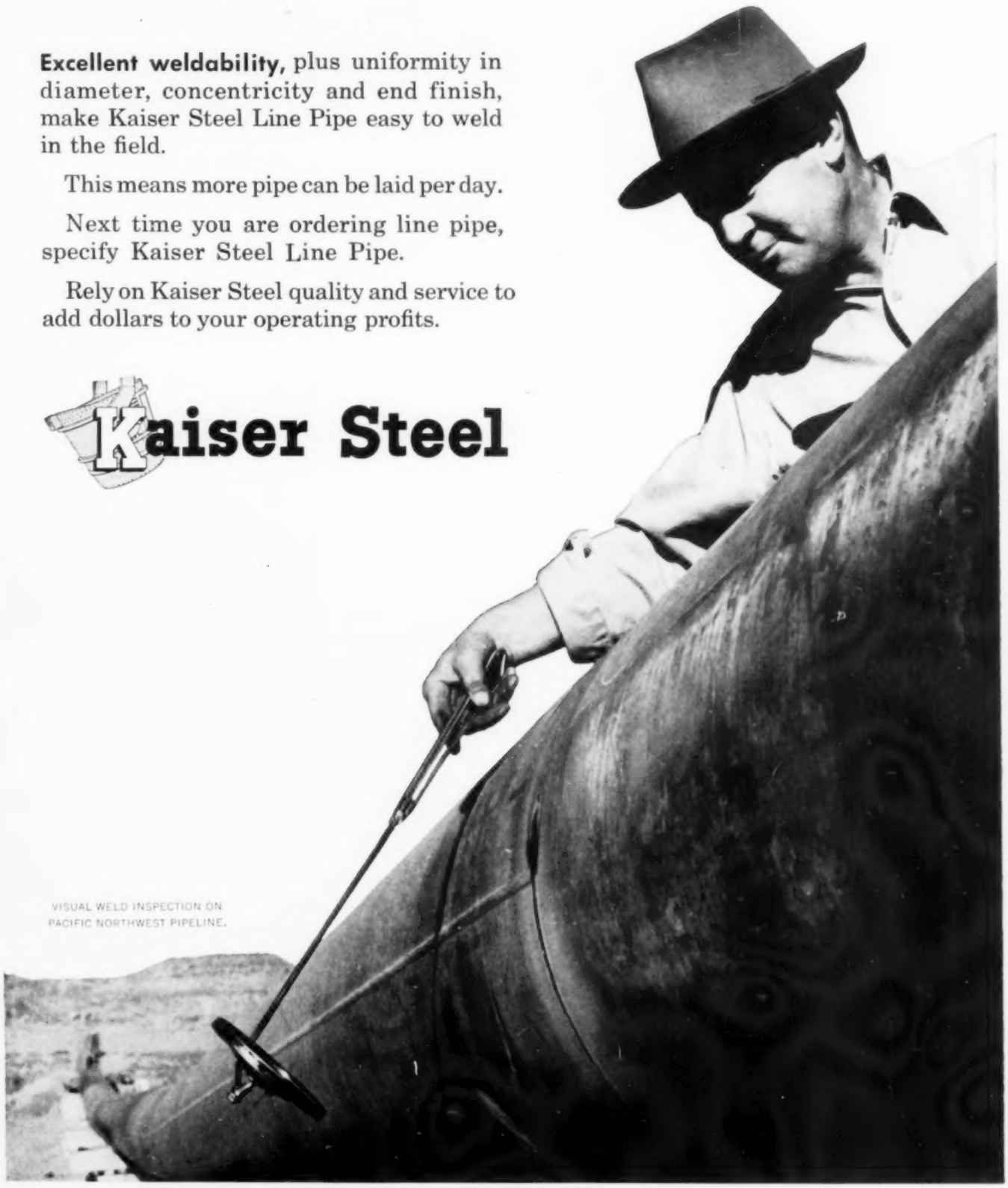

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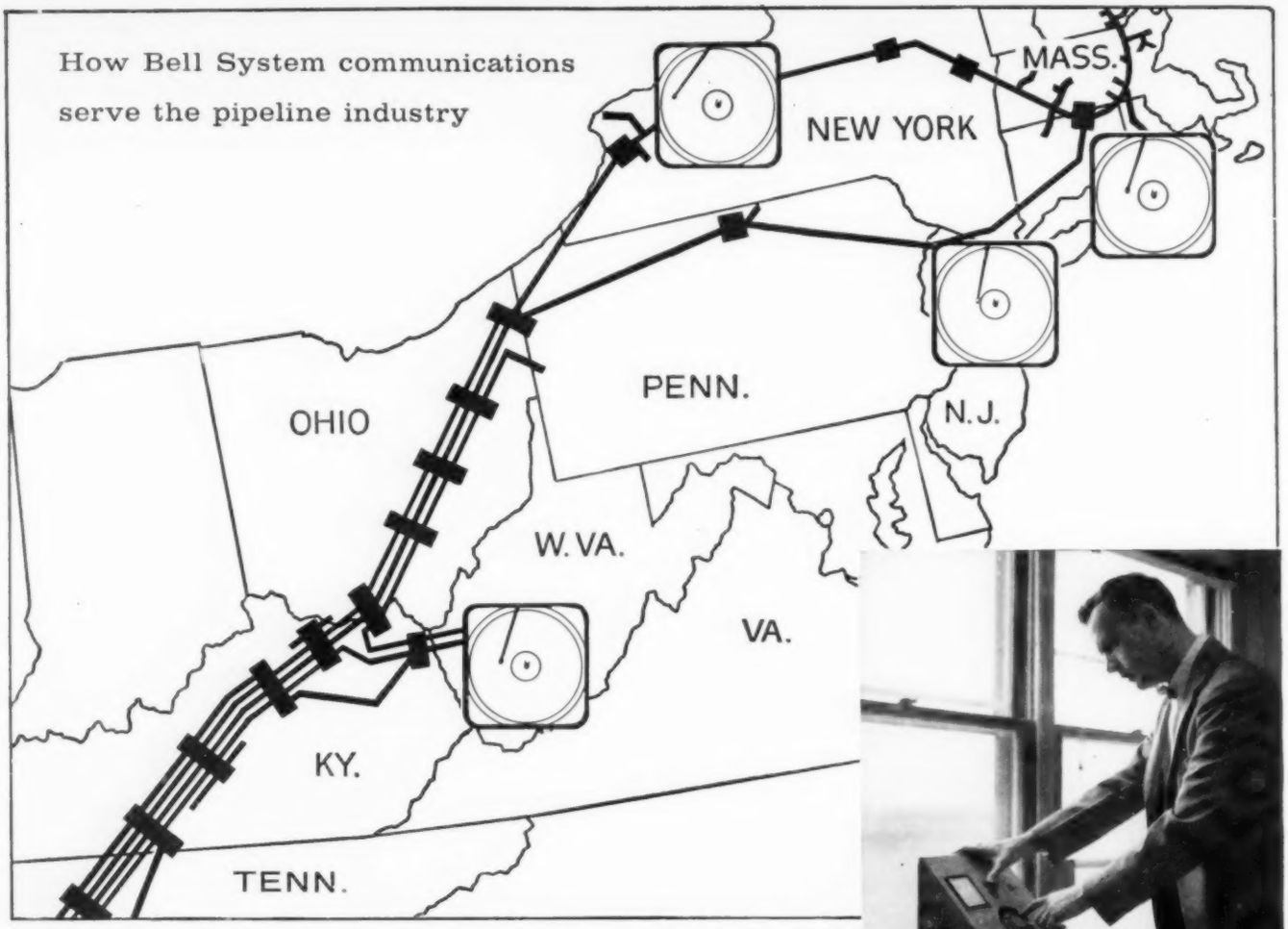

Bell System telemetering and remote control enables Tennessee Gas to centralize delivery dispatching in three areas (regional dispatching points indicated on map) in the northeastern U. S. Dispatcher operates remote station valves at market end of pipeline by code dialing.

Tennessee Gas pumps to market with the aid of remote metering and control

Bell System channels for remote metering and control permit Tennessee Gas Transmission Company dispatchers to regulate delivery at 16 unattended measuring points in the northeast.

Almost half of TGT's 1.8 billion cubic foot daily load is metered to four regional dispatching offices near major market areas. Over-all dispatching of the pipeline system is co-ordinated by Bell System private line telephone from Houston, Texas, headquarters.

TGT regional dispatchers open or close valves at delivery points by code dialing. A safety feature in the system enables them to stop delivery in 30 seconds in the event of an emergency.

• • •

Efficient communications can save manpower, keep costs down for you, too. Just call your Bell Telephone Company business office. A representative will discuss your needs.

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PRIVATE LINE TELEPHONE • PRIVATE LINE TELETYPEWRITER • DATA TRANSMISSION SYSTEMS

CHANNELS FOR: REMOTE METERING AND CONTROL • TELEPHOTOGRAPH • CLOSED CIRCUIT TV

PIPE LINE PANORAMA

Federal Control Noose is Pulling Tighter . . . Effects of federal control of natural gas prices are beginning to show. Colorado Interstate Gas says it faces bankruptcy under present FPC rates which are below fair field price for gas it produces. In fact, income under present rate decree won't even cover the company's current debts. Actual loss: $15 million annual rate cut and refunding $33 million in higher rates already collected. Colorado Interstate produces 62 percent of the gas it transports.

Harris-O'Hara Bill appears doomed for this session, with producers shedding no tears. Spokesmen say two Administration amendments would throw the producers right back where they were after the Phillips decision in 1950.

Texas Pipe Lines Have Their Say . . . Following up producers' first round opener in Texas Railroad Commission hearing on unconnected wells in West Texas, common-carrier pipe lines opened up with a salvo of their own. Arguments included:

- Producers want not only transportation for their crude, they want markets as well.
- If producers will provide buyer, and new pipe line system indicates it will show profit in reasonable length of time, wells will be connected.
- Steel shortage, not imports, is holding up progress on well connections.

What's New in Pipelining . . . Plastic coating for pipe lines may soon be common practice. Natural Gas Pipe Line Co. of America plans to use polyethylene protective tape coating on its 88-mile, 20-inch line between Bridgeport, Texas and Lindsay, Okla. First line to be coated was 122-mile, 22-inch line from Defiance, Ohio to Bridgman, Mich.

Line pipe metallurgists are optimistic about new pressure welding techniques for large diameter pipe. Though previous attempts at heating pipe ends in the field and merging them together have generally had bad results, new techniques are being worked out. Some show promise of correcting previous "bugs" in the method and may lead to faster completion of big lines.

Experimental work on visual X-raying unit for field use, not requiring the use of film, is approaching completion.

New Pipe Laying Barge to be Built . . . U. S.'s second ocean-going pipe laying barge will be completed by December. New vessel, to be built for Brown and Root by Levingston Shipbuilding, will cost $2.25 million, will be 350 ft. long, 60 ft. wide and 22.6 ft. deep. It will have stability to lay pipe in sizes up to 36 in. and work in wind velocities up to 40 mph. Will provide air-conditioned quarters for 88.

America's first deep sea barge, the $750,000 Magic, can carry crew of 46.

Middle East Pipe Line Shapes Up . . . Of 17 oil companies forming plans for 1500-mile, $840 million pipe line from Middle East to Mediterranean, 14 are American. Group is discussing possibility of double 38-in. or 40-in. line with capacity to move up to 1.4 million barrels of crude per day. U. S. and Great Britain both support the new line.

Texas Tops Nation in Pipe Lines . . . Texas' pipe line industry has more than $1 billion invested in nearly 90,000 miles of oil and gas lines, with both totals expanding at a rapid pace. Since 1947, more than 2000 miles have been added to the state's pipe line network each year—one fourth of the nation's pipe line mileage.

Designing the Modern Centrifugal Pump

A wide range of pump and impeller factors must be considered. "Specific speed," a guide number based upon capacity, head per stage, and pump speed can help the pipe line engineer obtain desired efficiency from the pump he selects.

By VAL LOBANOFF
United Centrifugal Pumps, Oakland, Calif.

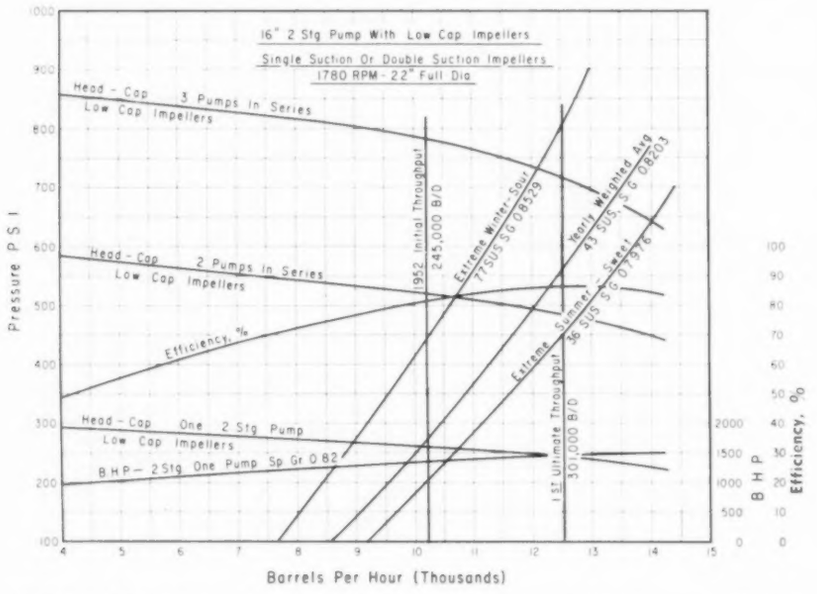

16" 2 Stg Pump With Low Cap Impellers
Single Suction Or Double Suction Impellers
1780 RPM - 22" Full Dia
Head - Cap 3 Pumps In Series
Low Cap Impellers
Head - Cap 2 Pumps In Series
Low Cap Impellers
Efficiency, %
Head - Cap One 2 Stg Pump
Low Cap Impellers
B.H.P - 2 Stg One Pump Sp Gr 0.82
1952 Initial Throughput
245,000 B/D
Extreme Winter Sour
77 SUS S.G 0.8529
Yearly Weighted Avg
43 SUS, S.G 0.8203
Sweet
36 SUS S.G 0.7976
Extreme Summer
1.5% Ultimate Throughput
301,000 B/D
Pressure P.S.I
B H P
Efficiency, %
Barrels Per Hour (Thousands)

FIGURE 1—Typical set of pipe line friction curves for a two-stage pump with low capacity impellers. Initial design capacity is 301,000 barrels per day.

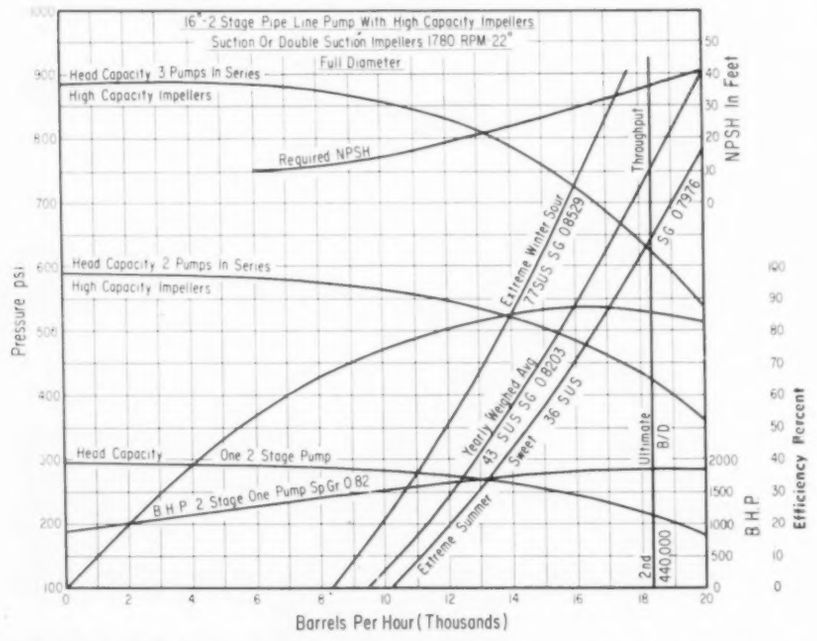


FIGURE 2—Typical set of friction curves for two-stage pump with high capacity impellers. Ultimate design capacity is 440,000 barrels per day for same type of pump considered in Figure 1.

RAPID GROWTH of the pipe line industry has focused attention on the importance of good engineering in the design, selection and operation of centrifugal pumps for a wide variety of specifications. Each class of service presents special design problems in fitting the pump to demands.

A background of theoretical knowledge plus years of practical experience go into the design of the most efficient pump for any given set of conditions. Experience is needed to predict performance without model testing and to predict pump operation when the impeller design or pump speed is varied. Variation in pipe line flow is often much greater than can be covered by the impeller cut; many of the pump drivers are constant speed electric motors.

It is not desirable or economical to change the complete pump or even a pump case to cover flow changes. Therefore, it is necessary to learn what pump performance will be if the same pump case is used and the design of the impeller or impellers is varied. Theory does not provide this information; but working with pipe line engineers, through field and factory testing, gives much needed experience which leads to a very accurate prediction of pump performance where only the impeller design is modified.

To select the most efficient pump for a pipe line station it is necessary to know:

1. All variations of flow; initial, normal and ultimate capacities (Friction curves).
2. Specific gravities and viscosities.
3. Line pressures.
4. Type of a driver and horsepower per pump.
5. Degree of corrosion, effect of pumped liquid.
6. Whether series or parallel operation is specified.

With this information, the designer can construct a new pump with the highest possible efficiency or adapt existing patterns to handle the required service, either booster or main line.

Boosters Cover Wide Range. Tank booster pumps are of a relatively simple construction. They are designed

for medium or high capacities, with low heads and low NPSH requirements. Their running speed usually does not exceed 1800 rpm.

A typical booster pump is a vertical unit, single stage, mounted directly to the motor shaft. It has rugged construction, designed for continuous operation with low NPSH, and a minimum number of wearing parts. No foundation is required; suction and discharge nozzles are of the same size, and in both vertical and horizontal alignment. This pump is installed like a valve in the pipe line; the pump case is not affected by pipe strains. A similar type booster with an impeller of a double suction design is normally used for larger capacities and lower NPSH requirements.

A "can" type booster pump is used by many pipe line companies where tanks must be drained completely or where NPSH available is zero at the pump suction nozzle. Length of the pump will depend on the NPSH requirements of the first stage impeller; the outer barrel or "can" is normally buried in the ground. This unit has been designed as a petroleum booster pump with an axially balanced impeller and has a minimum number of stages requiring normal thrust in the motor. There are several other types of pumps for tank booster service that are well known to the industry.

Main Line Pumps Complex. Main line pumps must be engineered to cover the full range of pipe line flow with the highest possible efficiency. This flow from initial stage to final stage varies as much as 50 percent and the pumps must adapt themselves to this variation with a minimum of mechanical change.

A popular type of construction for main line pumps is the horizontal, single stage unit with a double suction impeller. It covers a wide range of operation with running speeds varying from 1800 to 6000 rpm. This design lends itself to simplicity, high efficiency and low maintenance cost.

When the pressure requirements are above a single-stage pump, multistage units are used. Two stage pumps cover a wide range of capacities and medium heads. They can be designed with single suction or double suction impellers; efficiencies up to 90 percent can be obtained with this design. Two stage pumps are normally operated in series and are constructed with full balance, both radial and axial, with a heavy pump case for the maximum required pressure.

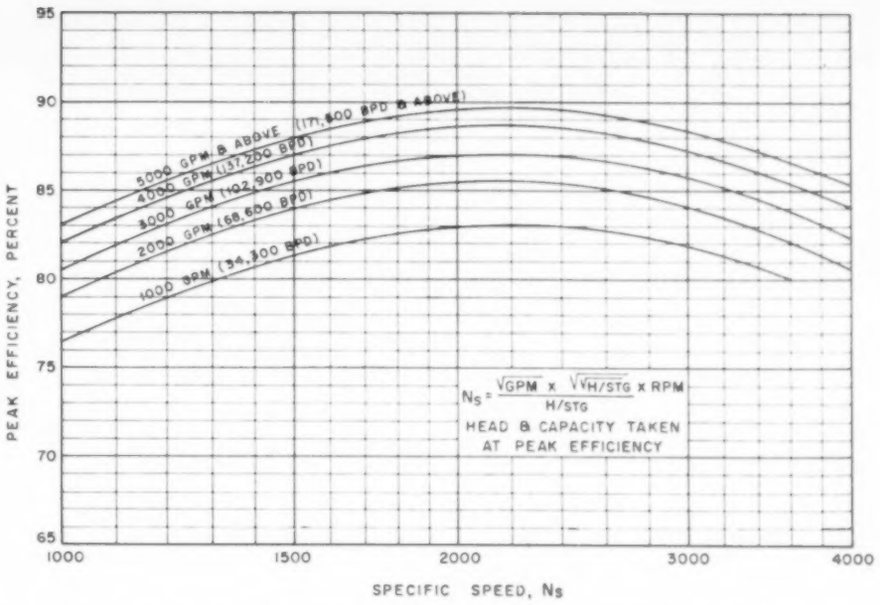


FIGURE 3—"Specific speed," an important guide number to the pump design engineer, may be related to pump capacity and efficiency to better predict performance. Plotted data is based upon actual hydraulic tests of standard pumps.

For medium capacities and high heads a pump with six stages finds wide application in products pipe line service. It is used for both parallel and series operation. This unit incorporates such features as high efficiency, full balance, and ruggedness.

Where required pressures are above 1500 pounds per square inch, a new type of horizontal split case pump is being adapted to pipe line service. For example, a 10-stage pump has been hydrostatically tested at 3500 psi. It is designed for medium capacities and high running speeds.

For high pressures, a vertical type multi-stage pump is advantageous. Electrical manufacturers have extended the horsepower of vertical motors up to and including 800 hp at 3600 rpm. With extended horsepower ratings, vertical high-pressure pumps are being used more widely in pipe line service.

A typical unit is a barrel type multi-stage pump with a first stage impeller at the bottom for best performance with low suction; it requires a normal thrust motor. For the same flow the vertical unit is more efficient than a horizontal one. It is rarely adaptable for series operations and

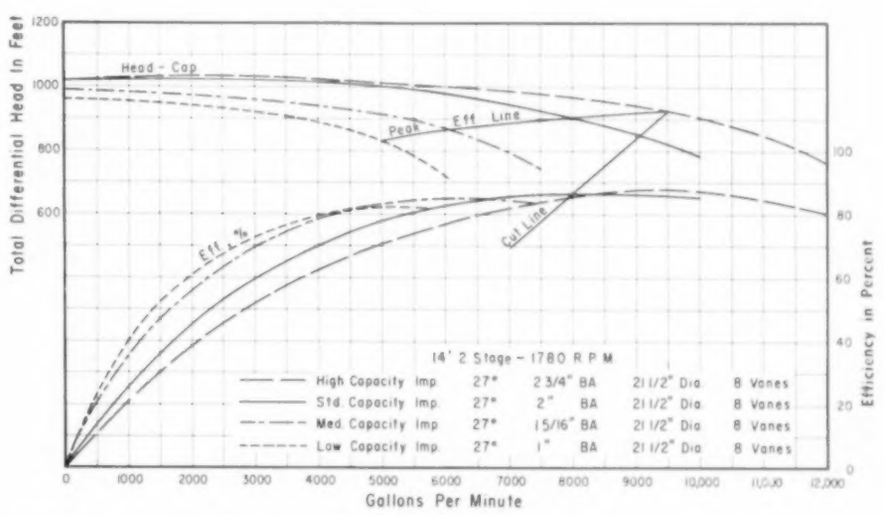


FIGURE 4—Hydraulic tests show the effect of varying the impeller size on a two-stage pump operating at 1780 rpm.

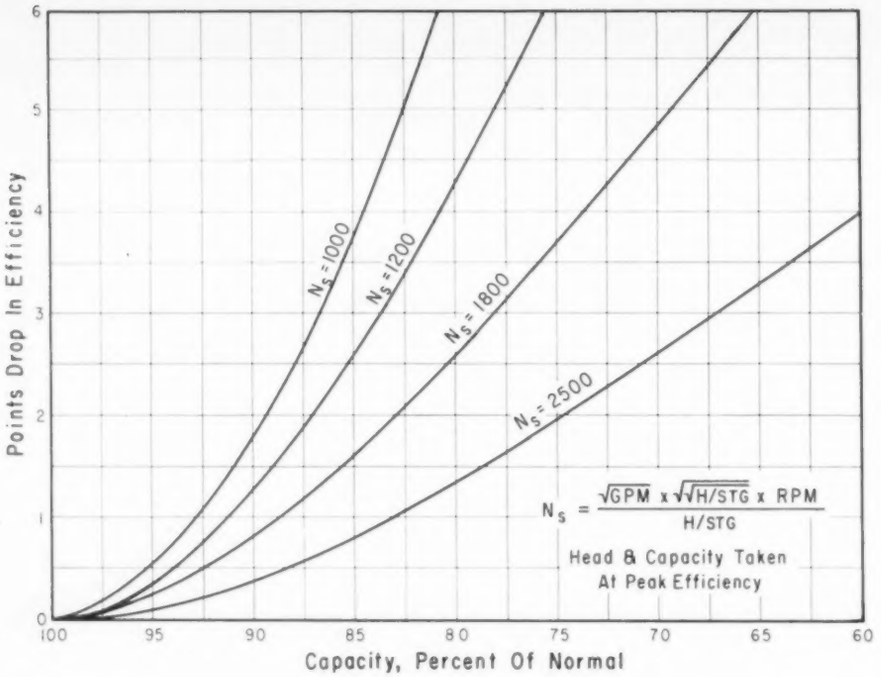

Points Drop In Efficiency
Capacity, Percent Of Normal
Ns = 1000
Ns = 1200
Ns = 1800
Ns = 2500
Ns = √GPM x √√H/STG x RPM / H/STG
Head & Capacity Taken At Peak Efficiency

FIGURE 5—Performance curves relate efficiency and capacity for various size impellers in the same case. "Specific speeds" are used as the parameter.

maximum flexibility. It has only one stuffing box, and requires a minimum of building space for installation.

Watch Mechanical Design. For each type of pipe line pump there are several mechanical design features that should receive attention:

1. To cover a wide range of operation with a minimum of wear the pump must be in "radial balance." This can be accomplished by a "double volute" design, by a "staggered volute" design or by having a diffuser type case. All three methods are equally effective.

2. To provide thrust bearings with the longest possible life each pump must be axially balanced. An opposed impeller arrangement on the shaft will keep the pump in balance and eliminate use of complicated balancing devices.

3. Pump shafts should be free to expand, and of sufficient stiffness to minimize deflection. Assembling of impellers on the pump shaft with a shrink fit adds greatly to its stiffness. The opposed arrangement of impellers also keeps the shaft in tension which is a desirable feature in any rotating machinery.

4. Experience shows that wherever possible, the pump case should be designed with the suction and the discharge nozzles in both vertical and horizontal alignment. In addition, the center line of the nozzles should be in line with the pump feet. This feature eliminates any effect of pipe strains on the pump case and adds to the ruggedness of the unit.

5. Bosses, drilled and tapped, must be provided for shutdown devices on bearing housings, on pump cases and mechanical seals. In most automatic pipe line stations the pumps should be furnished with a vibration recorder. It is usually installed on the outboard bearing housing.

6. The pump case must be designed

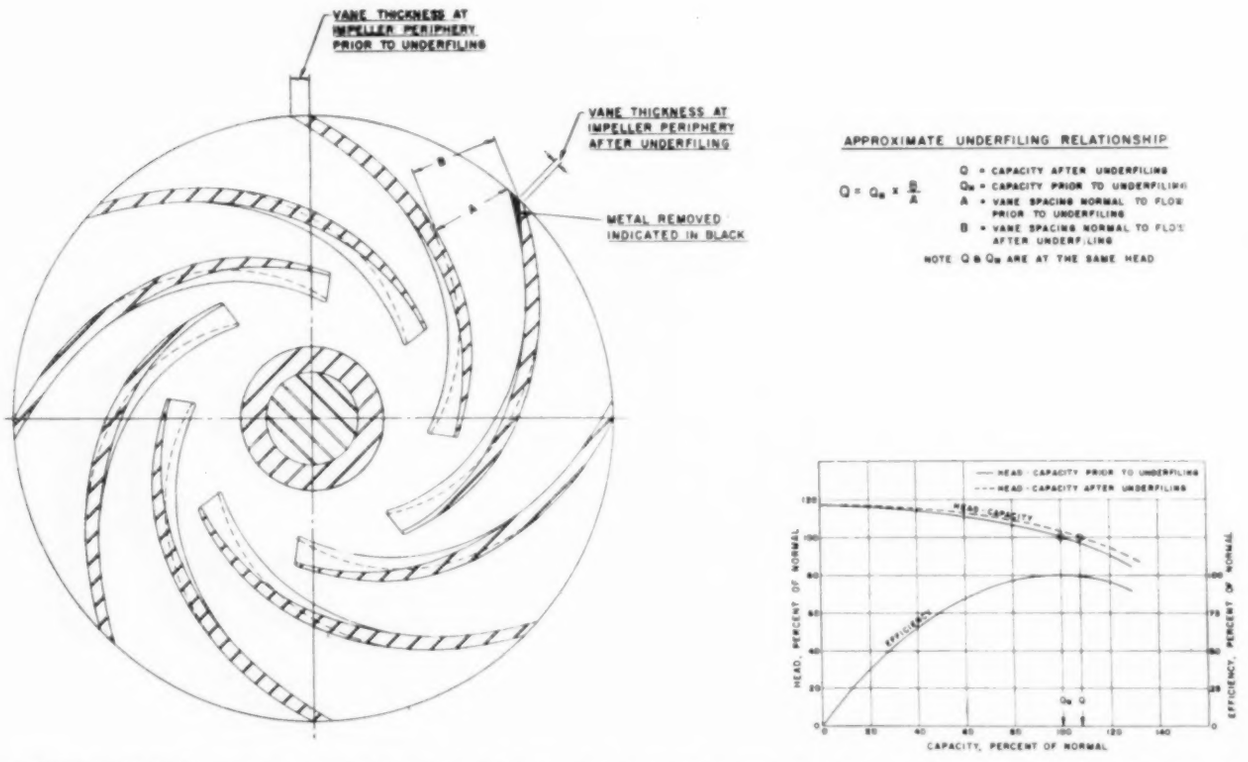

VANE THICKNESS AT IMPELLER PERIPHERY PRIOR TO UNDERFILING
VANE THICKNESS AT IMPELLER PERIPHERY AFTER UNDERFILING
METAL REMOVED INDICATED IN BLACK
APPROXIMATE UNDERFILING RELATIONSHIP
Q = Qo x B/A
Q = CAPACITY AFTER UNDERFILING
Qo = CAPACITY PRIOR TO UNDERFILING
A = VANE SPACING NORMAL TO FLOW PRIOR TO UNDERFILING
B = VANE SPACING NORMAL TO FLOW AFTER UNDERFILING
NOTE Q & Qo ARE AT THE SAME HEAD
HEAD - CAPACITY PRIOR TO UNDERFILING
HEAD - CAPACITY AFTER UNDERFILING
HEAD, PERCENT OF NORMAL
EFFICIENCY, PERCENT OF NORMAL
CAPACITY, PERCENT OF NORMAL

FIGURE 6—Underfiling removes metal from the underside of the impeller vane. It increases the area at the periphery of the impeller between all vanes, thereby increasing the capacity at peak efficiency.

in such a way that wide and narrow impellers can be installed without any mechanical changes. It took many years of research, commercial testing and field testing to learn how to provide for this feature with a minimum of loss.

7. All cooling jackets must withstand full line pressure for product cooling.

8. All pipe line pumps are furnished with mechanical seals in the stuffing boxes, and with one or the other type of seal failure shutdown devices. There are a number of successful types of mechanical seals.

9. The impeller (or impellers) should be of the highest possible efficiency to cover the full range of pipe line flow. Years of experience are required to properly engineer the design of several efficient impellers in the same pump case.

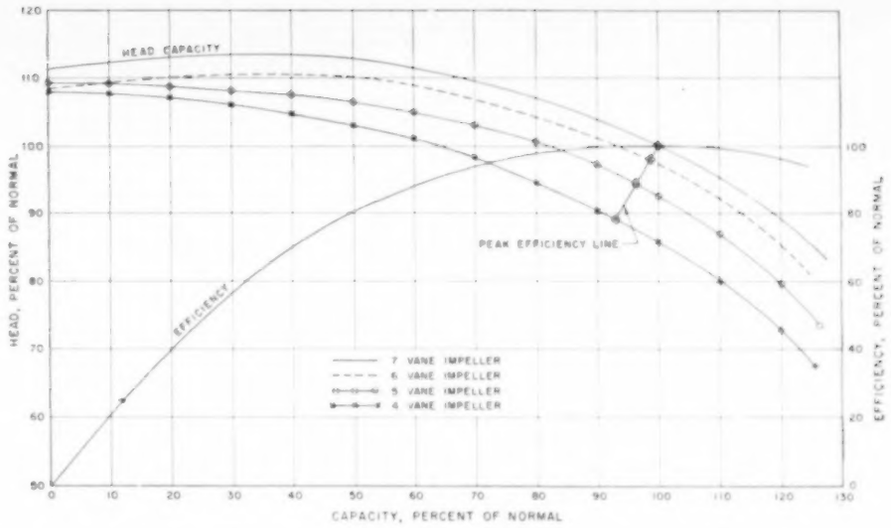


FIGURE 7—Degree of steepness of the head capacity curve may be varied by removing vanes from the impeller pattern. For a given impeller diameter the highest head is obtained with the largest number of vanes.

Selecting Right Pump. Typical pipe line friction curves are shown in Figure 1 for an initial capacity of 301,000 barrels per day and in Figure 2 for a final capacity of 440,000 bpd. Pipe line pressure is assumed to be 700 psi. The driver is an electric motor rated at 2000 hp and 1800 rpm. Specific gravities and viscosities are also shown on the friction curve. For flexibility three pumps per station were selected in this example.

"Specific Speed"—a Good Design Tool. In selecting this new pumping equipment, design engineers first looked at capacity ratings and saw that variation from initial to final flow was 43 percent (this means a low and normal capacity impeller is used). For prediction of performance and design purposes normal capacity was considered as design capacity. Once de-

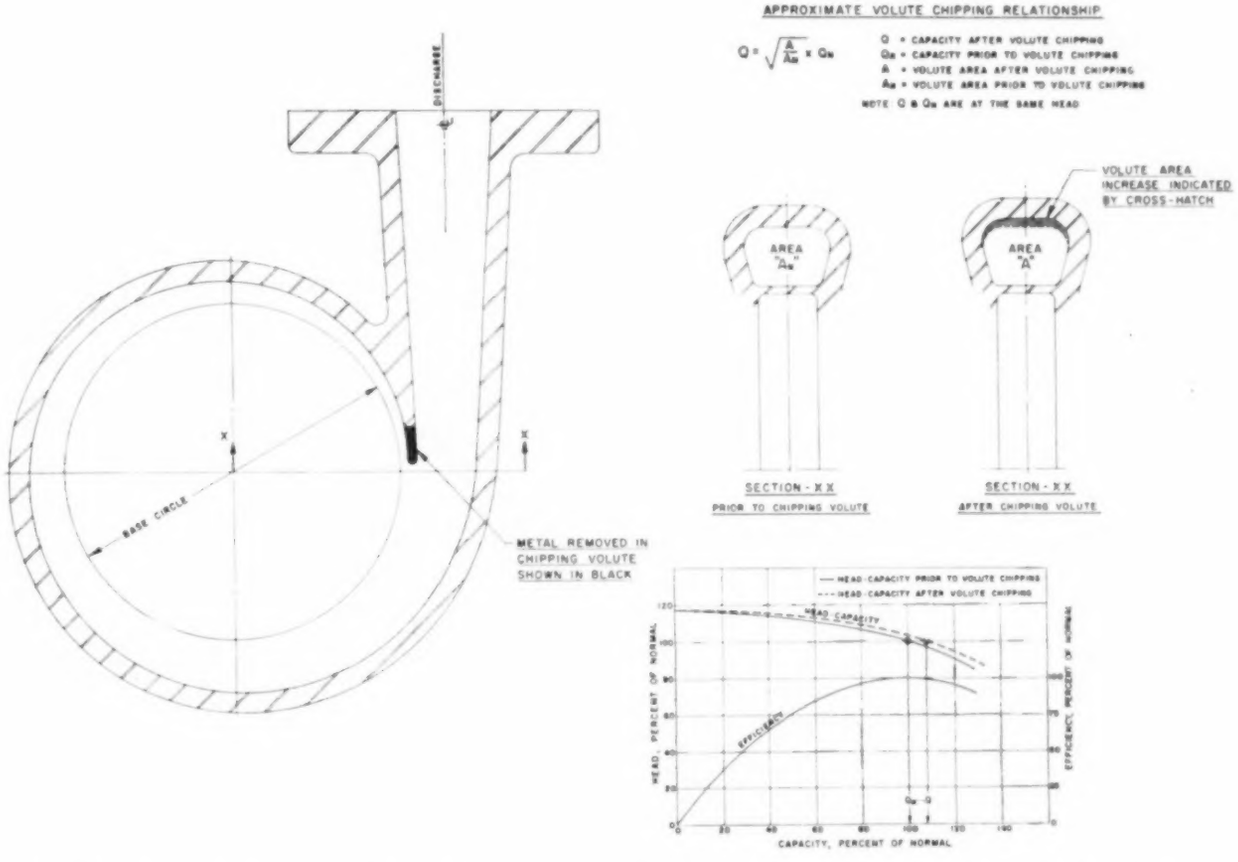

APPROXIMATE VOLUTE CHIPPING RELATIONSHIP
Q = CAPACITY AFTER VOLUTE CHIPPING
Q = CAPACITY PRIOR TO VOLUTE CHIPPING
A = VOLUTE AREA AFTER VOLUTE CHIPPING
A = VOLUTE AREA PRIOR TO VOLUTE CHIPPING
NOTE: Q & Q ARE AT THE SAME HEAD
DISCHARGE
BASE CIRCLE
METAL REMOVED IN CHIPPING VOLUTE SHOWN IN BLACK
VOLUTE AREA INCREASE INDICATED BY CROSS-HATCH
AREA "A"
AREA "A"
SECTION - XX
PRIOR TO CHIPPING VOLUTE
SECTION - XX
AFTER CHIPPING VOLUTE
HEAD CAPACITY PRIOR TO VOLUTE CHIPPING
HEAD CAPACITY AFTER VOLUTE CHIPPING
HEAD CAPACITY
EFFICIENCY
HEAD, PERCENT OF NORMAL
EFFICIENCY, PERCENT OF NORMAL
CAPACITY, PERCENT OF NORMAL

FIGURE 8—Chipping of the volute lip removes metal at throat, increasing the volute area. Peak efficiency will move slightly to the right and pump efficiency drops one or two points.

sign capacity, head per stage and a rotating speed are known, designers calculate the "specific speed."

"Specific speed" is a guide number, essential to the pump designer for all of his work. It should also be used by pipe line engineers to establish expected pump efficiencies. The "specific speed" for the above example is 2500. Figure 3 shows the relationship between "specific speed," efficiencies and capacities. This is not a theoretical graph, it is based on actual hydraulic tests of pipe line pumps.

Such factors as effect of crossovers in multi-stage pumps, large shafts, clearances and bypass capacities for cooling are taken into consideration. It can be referred to for either single suction or double suction impellers. For the "specific speed" of 2500 and capacity above 5000 gpm, efficiency of the specified pump at the design capacity is 89 percent.

Experience "Backs Up" Specific Speed. To predict the efficiency of a low capacity impeller the "specific speed" graph cannot be used, instead it is necessary to rely on experience. Here again, a great number of tests of different types of pipe pumps give us the background information necessary for establishing performance of the impellers of different width and variable designs.

About the Author

VAL LOBANOFF, chief engineer for United Centrifugal Pumps, has had many years' experience in all phases of the design of centrifugal pumps for pipe line and process applications. He was made assistant chief engineer of United Pumps in 1949 to devote his activities to engineering problems. He is active in A.S.M.E., Professional Engineers of California, Pacific Coast Electrical Association and other engineering and professional groups.

Selecting the Impeller. Figure 4 shows one of the hydraulic tests on a 14-inch, 2 stage pump. Width of the impellers were changed from 2¾-inches to 1-inch, in four steps. The 2¾-inch impeller peaks at 9500 gpm and has an 87 percent efficiency; while the 1-inch wide impeller peaks at 5000 gpm and has 82 percent efficiency. With a 52 percent reduction of capacity, efficiences were still maintained above 80 percent. Lesser reduction in capacity will result in smaller efficiency loss.

Change in the impeller design within a given pump case is to some degree related to a "specific speed" and to a running speed. Slow speed pumps maintain better efficiencies with low capacity impellers; also, pumps of higher "specific speed" respond with higher efficiencies to a low capacity impeller.

A tabulation of tests of various impellers in the same case produced the graph shown in Figure 5. This represents a trend to establish performance for variable capacity impellers in the same pump case. Reduction of capacities is plotted against loss of efficiencies for different "specific speeds." A rating of 67 percent of normal capacity and a "specific speed" of 2500 gives an efficiency drop of four points.

By going back to the previous examples, results of calculations show that engineers selected a 16-inch, 2-stage pump with normal flow efficiency of the pump at 89 percent; efficiency of the low capacity impeller is 85 percent.

Effect of Impeller Modifications. In addition to the changing of impellers, variation in performance can also be accomplished by minor changes in a given impeller. These changes are not as effective, but can be very helpful when properly applied. Figure 6 shows the result of under-filing of the vanes. The underfiling removes metal from the underside of the impeller vane and increases the area at the periphery of the impeller between all vanes, thereby increasing the capacity at peak efficiency.

This increase is directly proportional to the dimension *A* over *B*. The head rating will move to the right in a straight line from Q to Q_u. As a rule the efficiency remains either the same or slightly better. The curve shows that the most effective gain is to the right of the peak efficiency. "Shutoff head" does not change with underfiling. Therefore, the the gain to the left of the peak efficiency became smaller when approaching the shutoff point or zero capacity point.

Vanes Influence Performance. It is possible also, to vary the degree of steepness of the head capacity curve by removing the vanes from the impeller pattern. Pump performance with different number of vanes is shown on Figure 7. Note that for the same impeller diameter the highest head is obtained with the largest number of vanes. As vanes are removed the shutoff head stays relatively the same, but at peak efficiency the head drops and H-Q curve becomes steeper: peak capacity moves slightly to the left and efficiency remains about the same.

Similar results are obtained with a change in discharge angle of the vane at the periphery of the impeller. In normal design the maximum number of vanes is 7; the minimum is 3.

Chipping the Volute. When capacities increase by changing impellers has reached its limits, further gain is possible by chipping the volute lip in the pump case. By this means metal is removed at the volute throat, thereby increasing the volute area. Figure 8 shows the effect on pump performance due to this chipping. Peak efficiency will move to the right in the square root ratio of the new area to the old area. Pump efficiency will normally drop 1 to 2 points with this change.

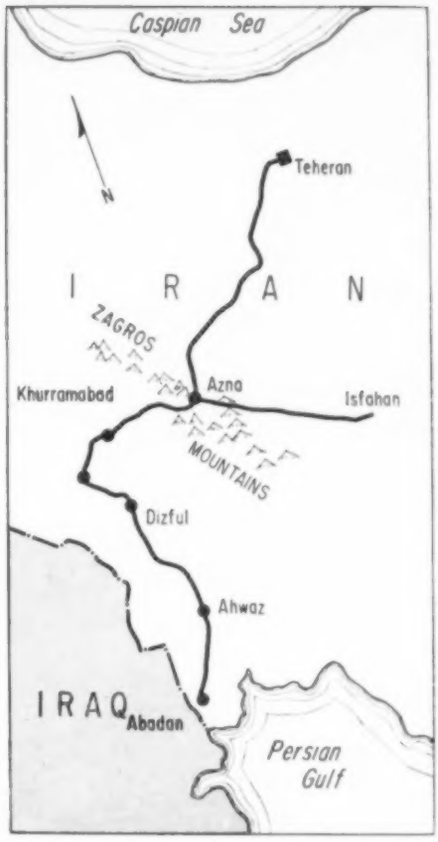
Consider Viscosity Correction Factors. Experience shows that the viscosity correction factors are less for multi-stage pumps than for the single-stage pump. This is probably due to heating of the oil as it is going through stages giving a better over-all factor.

What About Future Design? These are the tools available to the pump designer to help him give the pipe line engineers the equipment needed. Larger pipe lines, adaption of gas turbine drivers, higher horsepower and higher speeds for the pumps are coming. Where capacity variation is too great, use of hydraulic couplings likely will be considered. More automatic devices and safer mechanical seals are in the very near future.

—**The End**

Products Line Conquers Iranian Mountains

New 700-mile, 10-inch line crosses the Zagros Range to deliver 30,000 barrels daily from the Abadan refinery to Teheran.



Route of the 700-mile products line traverses desert, the Zagros Mountains and irrigated agricultural regions. The new line follows the railroad route from Abadan northward to Teheran.

AFTER CROSSING desert plains and the rugged Zagros mountain range, the new 700-mile, 10-inch products line of National Iranian Oil Company will deliver products from the Abadan refinery to Teheran early this summer.

First section of the line from Abadan to Ahwaz was completed prior to 1955 when National Iranian Oil contracted the 300-mile portion from Ahwaz to Azna to Costain-John Brown Ltd. of London. Societe Entrepose of Paris is now completing the 270-mile leg from Azna to Teheran. Williams Brothers, Limited, provided technical assistance on the project.

Completed cost of the line will be over $32 million. Initial capacity is about 30,000 barrels of products daily. Early this year shipments of up to 10,000 barrels of kerosine were pumped as far as Azna daily. Six pump stations will be in operation initially. Plans call for expansion to 13 stations later.

Pipe used in the new line is 10-inch seamless, conforming to API specification 5LX-46 with a minimum wall thickness of 0.279 inch. Some pipe used in mountain regions had wall thicknesses up to 0.344. Pipe was supplied by British and French manufacturers.

Rugged route of the line parallels the Ahwaz-Teheran railway. Its path crosses over 220 miles of desert, 200 miles of mountainous terrain and 165 miles of hill country. From an elevation of 80 feet above sea level at Ahwaz, the line climbs to 7500 feet in crossing the Razan Pass and the Zagros Mountains. The Rey terminal near Teheran is at an elevation of 3400 feet. The first 100 miles from the new Ahwaz pumping station crosses the Iranian plains.

Right-of-way in the mountainous regions lay along the swiftly running Kashgan River. Depths of the river varied from 2 to 20 feet according to the season, so sites of 23 river crossing were selected carefully. The longest crossing was 1700 feet across the Karun River near Ahwaz.

In many places, the only work location was along the road carved out of the mountains; only 18 feet wide on one side of the gorge. Gradients of one in three were often encountered. Temperature during construction along

Blasting was called for on many miles of the right-of-way across the Zagros Mountains. Even with the tough conditions met, construction progressed at an average rate of 1½ miles a day.

Plenty of rock on the 300-mile mid-section of the line made the going difficult for the British contractor, Costain-John Brown.

the line ranged from below freezing to above 130 degrees. Average speed of construction was 1½ miles a day; progress on exceptional days reached as high as 3 miles.

Biggest obstacles to line construction were the numerous irrigation ditches that made up a network in the agricultural plains area. Here the line had to be laid 3 feet below these ducts, some of which were as deep as 10 feet. To avoid interruption of water flow temporary carrier pipes were laid under the ditches. After the line was completed irrigation water was returned to the original channels.

Twenty-three river crossings were made by the Iranian line. This bridge over the Ab-I-Khoramabad River is in tight quarters. At some sites along the mountain route only 18 feet of working room was cut through the gorges.

Ditch was made with conventional rotary bucket ditching machines except in the rocky mountainous terrain where many miles of blasting and backhoe work were required.

Electric, Diesel Stations Move Products. Six pump stations will enable the new line to deliver 30,000 barrels of gasoline per day to Rey as soon as the line is completed. Seven additional stations will hike capacity to 60,000 barrels daily according to future expansion plans.

The first pump station at Abadan has two electrically driven seven-stage centrifugal pumps. One will be kept in standby service normally. Stations 2 through 6 are equipped with three diesel-driven centrifugal pumps. Two of the 540-horsepower units are in operation and one is on standby. Each is rated at 700 gallons per minute, 500 rpm, at pressures of 1000 psi. Additional stations are located at Bedrawi, Afrenah, Ahwaz, Azna and Khurramabad. In the mountainous area, 12-stage multiplex pumps are driven by supercharged diesels through a gear box transmission. Only the Ahwaz units pump in series, the remainder operate in parallel because of the high static heads encountered. To cut down on vaporization of motor fuel at the highest points on the line a minimum back pressure of 80 feet of head is maintained constantly.

Tanks Float on Line. Stations 2 through 6 have three balance tanks each of 20,000-barrel capacity which will always be maintained half full. Contents of these tanks will be automatically floating on the line and will be changed over as an interphase passes through each station. In this manner, whenever a section of the line has to be shut down for a few hours, it will not be necessary to interrupt flow throughout the entire line. Any loss of suction pressure at any given station will automatically connect the pumps to the balance tanks through electrically driven booster pumps.

The line is designed to operate at a maximum pressure of 1200 psi. Due to the rugged terrain traversed, it will be necessary to operate the line with back pressure. At the Rey terminal, the back pressure will be 650 psi. Each station has additional diesel engines for the generation of electricity for auxiliaries and for domestic requirements of the station.

Radio Facilities Unattended. A 24-channel VHF communications system is being installed along the pipe line route. There will be 27 unattended repeater stations, each with twin diesel generators, radio equipment and mast. All radio equipment includes an automatic switching arrangement in the event of breakdown.

Due to the ruggedness of the terrain and the necessity to place radio equipment at the highest elevations along the route, it has been necessary to isolate the radio stations from other facilities including other sources of electric power generation. As a result,

most of the stations are more than six miles away from the pipe line and some of them are as far away as 25 miles.

Corrosion Protection Complete. Before construction of the line a soil resistivity survey was made along the route. For the first 90 miles, coastal plain soils had a high salt content and low resistivity: remainder of the route across desert areas and mountains varied widely in corrosive environment.

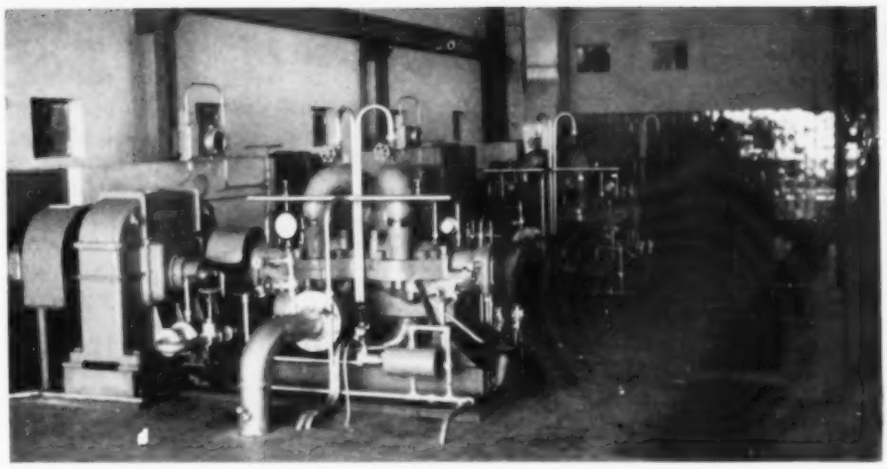
On the basis of this survey, estimates of current consumption for the cathodic protection design were worked out. After the line was completed, current drainage surveys were made to determine what power would be taken from the pumping station auxiliary power units for rectifier protection unit load. At intermediate points diesel-driven motor generator units in unattended blockhouse installations provided needed current.

The entire line has been coated with a system of coal tar primer enamel, and with glass fiber inner wrap, followed by an outer wrapping of Kraft paper. An extra wrap of glass fiber was used in rocky areas.

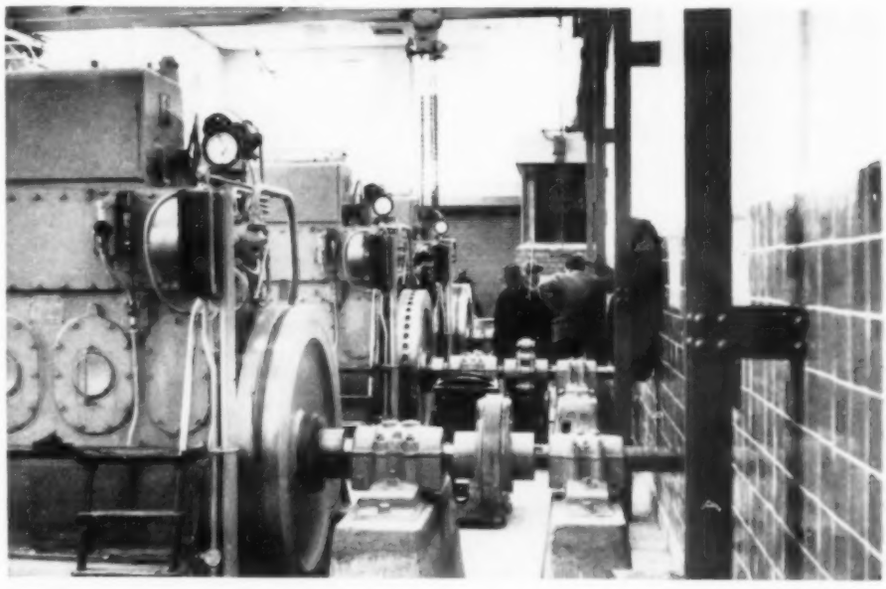
Future Laterals Planned. The pipe line will directly serve five terminals, according to current plans. Other NIOC installations will be supplied by tank trucks and railway tank cars. In addition, two new spur lines are projected to effect more widespread distribution of products from Abadan. A 200-mile, six-inch pipe line spur from Station No. 6, located 200 miles south of Teheran, will be built to Isfahan, former capital of Iran. This line will start at an elevation of 6400 feet, climb to 8500 feet in 36 miles and terminate at Isfahan at 4700 feet. The Ahwaz-Teheran line is the highest pipe line in the Eastern Hemisphere, at least in the Free World part of it, and the new spur will surpass the main line's highest elevation.

Pumps on the Isfahan spur will be duplex, reciprocating, driven by 540-hp diesel engines. Maximum line pressure will be 1700 psi and capacity will be 20,000 barrels of gasoline per day.

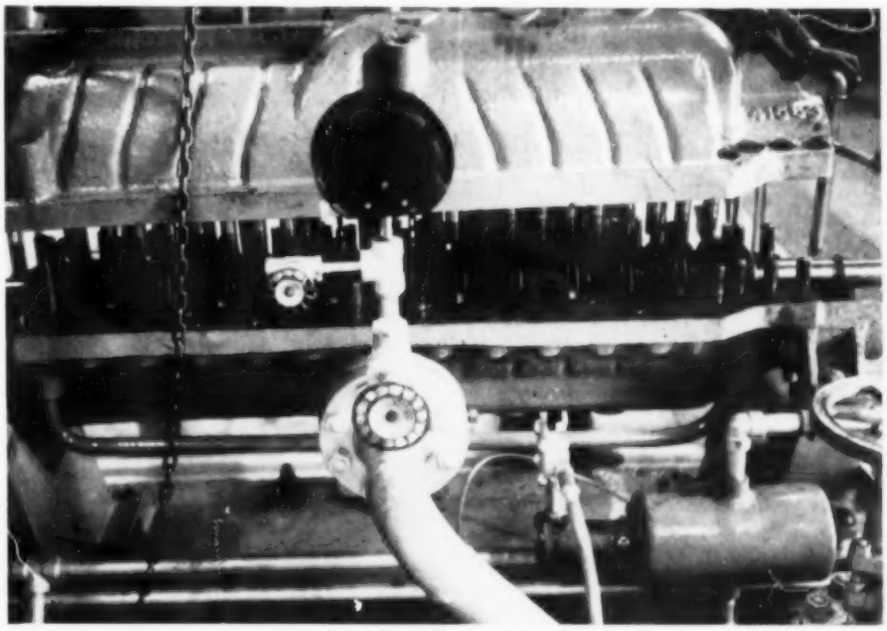
The other projected spur will be a 220-mile, six-inch line from Teheran to Resht in northwestern Iran along the southwestern shore of the Caspian Sea. —**The End**



Pump station at Ahwaz has two 540 horsepower diesel driven, centrifugal units pumping in series. An additional unit is on standby.



Supercharged diesel engines drive centrifugal pumps for five of the stations. This view on the engine room side of the firewall shows preliminary service inspection of the units.



Twelve-stage centrifugal unit is shown here being assembled at station three.

Modern Automatic Units Boost Capacity

Rancho's Katy Station increased daily system capacity 25,000 barrels with remotely controlled units. Station will be unattended except for routine checks by operating personnel.

LATEST AUTOMATIC controls, protective devices and complex communication systems for transmitting information to the dispatching office, make the Katy station of Rancho Pipe Line System one of the most modern of its kind. Typical of the degree of automation is the scraper running technique.

There are two scraper detectors at the Katy station. One is located upstream approximately 700 feet from the station bypass valve and the other is located adjacent to the downstream side of the bypass.

The contact on the upstream detector energizes a relay which automatically shuts down all units in operation, closes the station suction and discharge valves, and opens the bypass valve. At the same time, the scraper passage indication lights on the local and supervisory control panels will change from green to amber.

When a scraper reaches the downstream detector, a contact similar to the one used on the upstream detector energizes the relay. At this time the scraper passage indication lights change back to green, indicating that the station may be returned to normal operation. Katy station may be brought back on the line by the following steps at either of the control panels:

- Closing the bypass valve and opening the suction and discharge valves automatically.
- Pressing the respective unit "start" pushbuttons.

The bypass line around the main line valve at the Katy station is equipped with a check valve and an orifice plate. The plate retards the flow enough to kick the scraper on past the bypass line.

One Valve Regulates Station. There is a control valve between the station and main discharge valve which is actuated by the following conditions:

- Suction pressure
- Discharge pressure
- Flow (throughput)
- Power demand.

In addition to the above, a start-up controller takes over on shutdown. This control regulates the time to fully open the control valve on start-up.

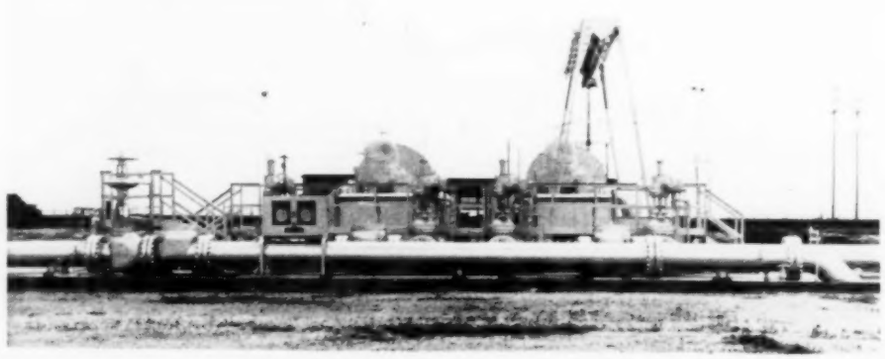
Rancho's Katy station is equipped, as are most of the other system installations, with an automatic sump installation. All drainage (pumps are bled 15 seconds automatically on start-up) is piped to an oil-water separator. This separator has a pump for each side operated by float-type switches. Oil is pumped directly into the main line and the water is discharged to a burning pit.

Dispatching Office Monitors Operation. The control panel installed at Katy is duplicated in Rancho's dispatching office in Houston. The Houston panel is equipped with additional indicating devices that allow complete monitoring of the operation at Katy station:

- A green and a red light indicates each alarm function. Green light shows normal conditions, and the red light abnormal ones.
- A white check light is located in the center of each set of indicating lights.
- Two pushbuttons and two breaker position lights (green and amber) for the outdoor breaker. These are located beneath the emergency stop button.
- Two indicating lights (green and red) monitor power failure at Katy.
- Two additional pushbuttons provide "check" and "alarm reset."
- The meters for suction, case, and discharge pressure, flow and demand are indicating only.

When one of the red trouble lights goes on, it will flash off and on until the alarm "reset" button is pushed. The alarm "reset" pushbutton also silences an alarm bell. The "check" pushbutton enables operator to check all of the indications on the supervisory control panel.

Protective Devices Guard Equipment. Katy is equipped with both "lockout" and "non-lockout" protec-



Manifold area shows control valve at extreme left. Flow and pressure chart appear near center of picture, and the metal cabinets contain the protective mercoid "shut-down" controls.

tive devices. The lockout devices are connected to relays which operate a solenoid on the control switch. When this switch has moved to the "trip" position, and shut down the unit, the trouble must be corrected and control switch manually placed in the reset position before the unit can be restarted. The non-lockout devices protect the units from faults that are temporary and will correct themselves, such as a high case pressure. Under these conditions the unit is shut down but can be started again by pressing the "start-button," when the trouble has been corrected.

The protective devices are as follows:

1. *Mechanical*
   - A. "Non-lockout"
     - Low suction pressure
     - High pump case pressure
     - High pump case temperature
   - B. "Lockout"
     - High outboard or inboard motor bearing temperature
     - High outboard or inboard pump bearing temperature
     - Pump seal leakage
     - Vibration
2. *Electrical*
   - A. "Non-lockout"
     - Low AC voltage
     - Motor thermal overload
     - High motor temperature
   - B. "Lockout"
     - Motor current unbalanced
     - Motor overcurrent.

The pendulum-type vibration detector is mounted on the pump inboard bearing housing. This detector has a holding coil which disables the detector during start up, since during this operation there may be large vibrations and, after which any vibration in excess of normal operations will shut the unit down. Station will be shut down if the leakage around pump-seals becomes excessive. The mercury-type switch for this control is mounted with others, in the switch cabinet.

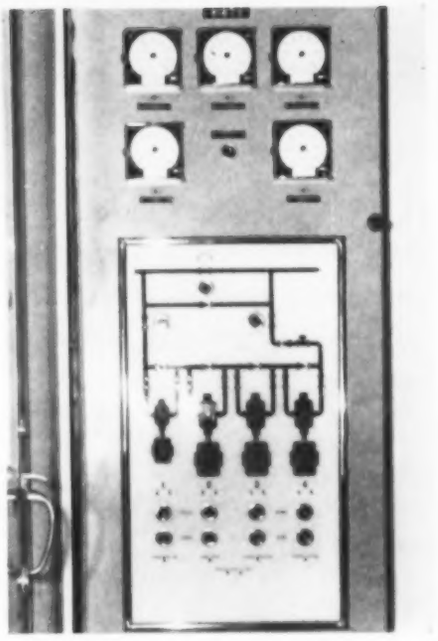
Control Room Separate from Pumps. The main difference in physical design of this particular station, as compared to the three original stations on Rancho's system is the separation of the pumping units from the control building. The pumping units at Katy are mounted on a concrete slab some 100 feet from the control building. There are two 2000 hp, 4160-volt, weather-protected, self-ventilated motors. These motors, which are not explosion proof, are designed for operation out-of-doors without any additional protection from the weather. The control building is of steel frame construction, asbestos clad and trimmed with brick in the front.

Units two and three of an ultimate four-unit station have been installed at the present time. One of the units is a "full" unit, while the other unit has an altered impeller, allowing it to operate at three-quarters of "full capacity. The future installation calls for addition of:

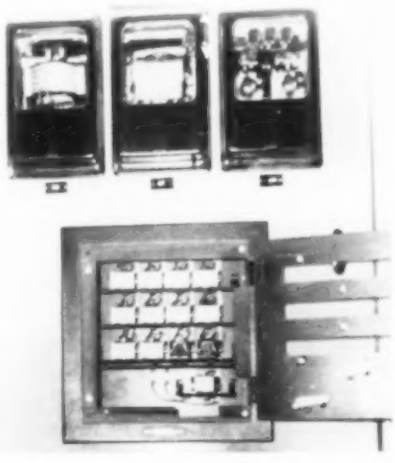
1. One unit, with impeller allowing 1⅛ "full" capacity and
2. One unit, ½ "full" capacity.

The above arrangement allows a wide range of operating flexibility in increments of ⅛ "full" capacity.

—The End

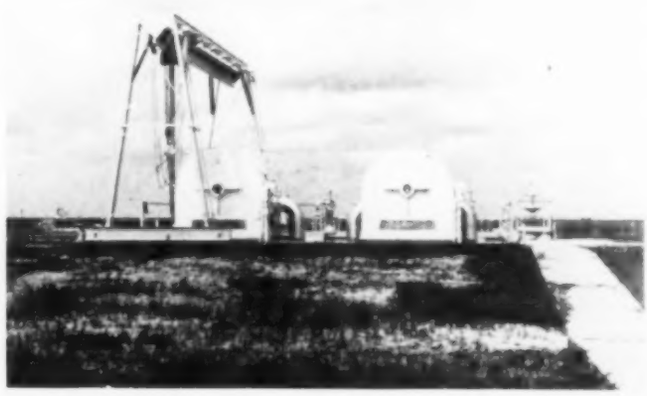


Compact control panel, duplicated in Houston office, gives picture of station operations. Katy Station can be brought on the line, or shut down, locally or from main office.



Mounted on the control cubicle, the annunciator flags indicate and identify an abnormal condition in the station operating equipment other than main line units.

"Skimmer-type" oil-water separator automatically pumps the oil into the main line and discharges the water to a burning pit. Main-line pumps are automatically bled into sump system at each start-up.



Weather protected type motors set on concrete slab some 100 feet from control building. Traveling I-Beam, on rails, and hoist are used for maintenance on both pumps and motors.

Economics of Cathodic Protection Design

Expected life of the pipe line, coating condition, power costs and availability govern design of the impressed current system. Here are some good points to consider in ground bed design, rectifier selection and unit spacing.

By B. J. DeHANAS
Service Pipe Line Company
Tulsa

CORROSION CONTROL MEASURES should be applied to a pipe line only if their use will result in advantages of greater value than the cost of the measures taken. This is an obvious thought that may often be overlooked. Most advantages may be stated in dollar values; but some conditions will be found that are difficult to convert to dollars and cents. In such cases, special "yard sticks" must be used to evaluate the situation.

The first step to be employed in the solution of a corrosion problem is to determine the economic factors involved. How much is the problem costing in dollars or operating disadvantages? Next the possible solutions and their costs are appraised. The solution that will show greatest advantage or dollar saving is selected. This solution may be the use of galvanic anodes, coating materials, impressed current installation or possibly a combination of all.

Use of an impressed current installation should be subjected to the foregoing examination and found economically sound for the particular situation before it is selected as a corrosion control measure.

In some cases a possible solution may be eliminated without extensive study because of practicability. As an example we might be considering the protection of a pipe line with joints which are coupled by an insulating type connector. Here impressed currents would not be practical unless measures were taken to bond the joints.

Consider These Points First. Each operating company will give different weight to the various factors of economic evaluation but speaking in general terms the following points should receive consideration:

1. Know that a problem does exist.
2. That the structure under consideration is necessary and should be continued in operation. The length of its productive life with respect to operation should be evaluated.
3. Cost of corrosion without control measures.
4. Cost of the control measure.
5. Expected life of the structure with and without the corrosion control measure.
6. Possible salvage and reuse value with and without the corrosion control measure.
7. Other factors which are difficult to estimate but might be of great importance; these may be such considerations as public safety, or health and welfare. Remote possibilities of damage of property which are extremely costly in dollars and prestige if they occur.

These factors should be set down in a calculation of dollar value of savings and costs, giving weight to time value of money, equipment depreciation, tax effect of operation costs, etc. The net savings or loss in dollars is computed. This result should then be weighed against the factors that cannot clearly be stated in dollars. The final decision is usually made by management after review of the above information in relationship to the overall company situation.

Two Sides to Design. The impressed current unit is not a cure-all. There are some advantages in its use and also some disadvantages. Each situation needs to be reviewed to determine if the impressed current unit is suitable for the application.

Here are some advantages:

- Simple and compact in installation and operation.
- Easier to check level of protection.
- Not affected by high resistance earth (to great extent).
- Large amounts of current may be supplied.
- Current cost less per KWH than other sources.

Disadvantages:

- Wasteful when large current drains used.
- Difficult to use when many foreign lines and structures are present.
- Will work only if the metal structure is surrounded by conductive media.

Factors Affecting Rectifier Unit Location. There are many factors that will determine the current requirement. They may be listed in part as:

1. Size and length of pipe line (s).
2. Bare or coated pipe.
   a. If bare, the resistance of the soil next to the pipe.
   b. If coated, the condition of the coating.
3. Physical layout of line, whether in congested areas or open country. Whether welded, coupled or screw line and others.

The most accurate way to consider these factors is to actually drain current from the pipe line. In other words, the pipe line will be put under cathodic protection by a temporary installation. It is usually not necessary to do this type of testing for the entire length of line. If such tests are run in areas that are representative of the conditions of the line then the rest may be calculated.

Testing provides information for what is called attenuation calculations. By reading the effect of various current drains on the drive voltage and polarization voltage and applying the attenuation formula to plot the data then the spread of any other current drain may be determined.

Economical Spacing of Units. The most economical spacing as far as power consumption is concerned would be the close spacing. On the other side of the ledger, the most economical spacing as far as material and construction cost are concerned will be the wide spacings (or fewer units).

In making the operating cost calculation, do not overlook the minimum power bill factor. There is no savings in designing a unit that requires only $3 per month power when the minimum power bill for that location is $10 per month.

Studies must take into consideration some other factors.

1. Power Availability. This will be extremely critical in spacing and sizing of units. In heavily populated areas power may be available at almost any location. In less populated areas availability of power and its location should be determined before unit spacing is decided upon.

2. Soil Resistivity. A general knowledge of the soil resistivity throughout the entire length of the line to be protected should be at hand before unit spacing and location are attempted. This factor, like power, could greatly affect the entire economic picture. A detailed soil resistance survey should be made at a proposed location to make final unit and ground bed design.

3. Foreign Structures. Location of "foreign" pipe lines and other structures should be established before exact unit locations are made.

Location of a unit close to such a structure could cause extreme damage if proper steps are not taken.

4. Accessibility. This factor is sometimes disregarded in making unit locations. It is not the most important factor but should be considered. It will be necessary to visit the units for inspection at regular intervals. Adverse weather conditions could make such inspection impossible at some locations. Here the human element should also be considered. Maintenance personnel might tend to slight a unit that was difficult to reach.

Ground Bed Resistance Governs. The most important factor in the annual cost of the ground bed is the resistance of the ground bed to earth connection. This factor is controlled by the following:

1. Soil Resistivity. For a given length and diameter any change in the soil resistance around an anode will cause a similar change in the resistance to current flow from the anode.

As an example of the significance of this relationship we may use the basic formula of the resistance of a hemisphere buried in the earth.

$$R = \frac{\rho}{2 \pi a}$$

in which

R = Resistance in ohms

ρ = Soil resistivity

a = Radius of a hemisphere

If we use a soil resistivity of 1000 ohms per cubic centimeter and a radius of 10 centimeter we have:

$$R = \frac{1000}{2 \times 3.1416 \times 10} = \frac{1000}{6.2832 \times 10}$$
$$= 15.9 \text{ ohms}$$

If we half the soil resistance to 500 ohms centimeter we also reduce the electrode resistance by half.

2. Length and Diameter of Anode, Whether Horizontal or Vertical. By developing our basic resistance formula further to the formula for a buried cylinder we have

$$R = \frac{\rho}{2 \pi L} \left(\log_e \frac{4 \times L}{a} - 1 \right)$$

in which

R = Resistance of ground bed cylinder

ρ = Resistivity of soil in ohms per cubic centimeter

L = Length of cylinder in centimeters

a = Radius of rod in centimeters

By using this formula we may now observe the effect of length and diameter on resistance.

First

ρ = 1000 ohms per cubic centimeter

L = 100 centimeter

a = 10 centimeter

We have

$$R = \frac{1000}{6.2832 \times 100} \left(\log_e \frac{4 \times 100}{10} - 1 \right)$$
$$R = 1.59 \ (\log_e 40 - 1)$$
$$= 1.59 \ (3.6889 - 1)$$
$$= 1.59 \times 2.6889$$
$$R = 4.28 \text{ ohms}$$

TABLE 1—Work Sheet Groundbed Design-Economic Comparison

LOCATION IDENTIFICATION M.P. 26.1—Mexia—Houston 12" D.L.

GROUNDBED TYPE 20 Anodes—9" x 10' Vertical, Using 3" x 60" Graphite Rod, Bed Laid out in Straight Line 20' South of Fence, Anodes 20' C. to C.

DESIGN CURRENT: ACTUAL 25 Amps + RESERVE OR OTHER USE 5 Amps = 30 A. TOTAL

Power Cost—Operation Expense

1.	Estimated Circuit Resistance "R"	=	.46
2.	$I^2 \times R$ = Watts 30^2 x .46	=	414
3.	Watts x 1.46 = KWH Per Month = 414 x 1.46	=	604
4.	KWH Per Mo. x Cost Per KWH = Power Cost Per Month	=	$18.30
5.	Power Cost Per Mo. x 12 = Power Cost Per Annum	=	$219.60
6.	Other Operation Costs	=	
7.	Total Operation Costs—Line 5 + Line 6	=	$219.60
8.	Net Operation Cost Per Annum—Line 7 less 50% Reduction for Tax	=	$109.80

Groundbed Construction Cost—Capital Expense

9.	Unit Cost Per Electrode 30.55 x Number of Electrodes 20	=	$611.00
10.	Unit Cost Per Foot Cable & Ditch .70 x Total Feet 380	=	$266.00
11.	Other Construction Costs	=	
12.	Total Construction Cost—Line 9 + Line 10 + Line 11	=	$877.00
13.	Total Cost = $877 x .10296* = Total Per Annum Costs	=	$90.30
14.	Net Per Annum Cost — Line 8 + Line 13	=	$200.10

Line 1

Groundbed Resistance	=	.35 Ω
Cable Resistance	=	.10 Ω
Pipe & Coating Resistance	=	.01 Ω
Total Estimated Cir. Resistance	=	.46 Ω

Line 4

Minimum	=	$5.20
1st 40 KWH At 8¢	=	$3.20
Next 40 KWH At 5¢	=	2.00
Next 524 KWH At 25¢	=	13.10
Total Cost Per Month	=	$18.30

Line 9

Anode	=	$9.75
Backfill 300 Lbs. @ 2.10 cwt	=	6.30
Splice Material	=	2.10
Labor & Equipment	=	9.60
Other Costs & Overhead	=	2.80
Unit Cost Per Electrode	=	$30.55

* Per Annum Rate 6% for 15 years.

Now let us double L to 200 centimeter

We now have $R = .796 (\log. 80 - 1) = .796 (4.382 - 1) = .796 \times 3.382 = R = 2.96$ ohms

Now instead of L let us double a to 20 centimeter

We now have

$$R = 1.59 \left(\log. \frac{4 \times 100}{20} - 1 \right)$$

$$= 1.59 (\log. 20 - 1)$$

$R = 1.59 (2.9957 - 1) = 1.59 \times 1.9957$

$R = 3.17$ ohms

As can be seen the effect of increasing length is greater than of increasing radius.

The factor found significant here also applies to horizontal anodes.

3. Number of Vertical Anodes. If one vertical anode has a resistance of 10 ohms then the resistance can be lowered to 1 ohm by adding 9 more anodes like the first. That is, if the soil resistivity is the same, and the anodes are far enough apart so that they do not interfere. Very generally speaking if the anodes are 100 diameters apart there will be no interference. In the above 10 anodes example, had they been placed at 25 diameters, then instead of 1 ohm resistance it would have been about 1.3 ohms or ⅓ more due to interference.

4. Depth of Burial of Horizontal Anodes. Depth at which horizontal anodes are buried will influence the resistance. This will not be as significant as the above changes in length and diameter but the deeper anode will have less resistance.

Costs Calculated Next. After the resistance of the ground bed is determined, then the power cost may be determined.

Assuming a ground bed of one ohm resistance power consumption per month would be

$I^2 R$ = watts $\times$ 1.46 = KWH per month

(This factor considers the rectifier operating at 50 percent efficiency.)

For a 20 ampere drain power demands are:

$20 \times 20 \times 1 = 400$ watts $\times$ 1.46 = 584 KWH

What happens if the current drain is doubled?

$40 \times 40 \times 1 = 1600 \times 1.46 = 2336$ KWH

Here KWH consumption is increased by four times. The cost of operating the 20 amp drain per month with 4c KWH power would be $23.36.

In order to find the most economical ground bed for the location it is best to try various numbers and sizes of rods finding their total operating cost per annum; then this cost is added to the per annum cost of the capital investment for each combination. The lowest combined cost is the most economical ground bed. A sample calculation is shown in Table 1.

Rectifier Size is a Function of:

- Current output desired
- Total circuit resistance

After the ground bed size and resistance has been set, the rectifier may be sized. The current and total circuit resistance will determine this size.

First the total circuit resistance will consist of ground bed resistance + cable resistance + resistance of pipe + coating and earth path (or R_g).

Next the circuit resistance times the current required = volts required + 2 volts (voltage required to overcome back force in graphite or surface resistance in high silicon iron) = total voltage required.

Now that the desired voltage and current rating of the rectifier are known, it may be desirable to add some current and voltage to these ratings to allow for seasonal variation and coating deterioration.

Ground Bed Life and Capacity. To some extent, the life of a ground bed may be calculated. This is not an exact calculation by any means. It is better to design with a current density limit on each anode. Manufacturers furnish this information in their trade bulletins. For the standard 3" x 60" graphite rod in backfill the recommended maximum drain is 4 amps (even this may be too high in wet conditions).

Size Cables Correctly. The cable, like the ground bed, will have a most economical size for the current drain, cable cost and power cost.

This calculation will be very similar to the ground bed calculation.

Here the cost of the power loss due to cable resistance is added to the per annum capital costs of the cable; the lowest such combination is the most economical size.

Factors Affecting Rectifier Function. Curves in Figure 1 show typical selenium rectifier efficiency data. Losses of transformer, and cable are not included.

It will be noted that when the amperage is held at 100 percent rating and the voltage dropped, the curve descends slowly; this indicates that

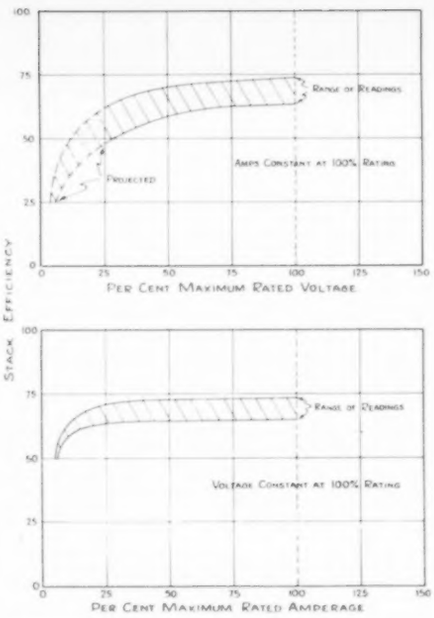


FIGURE 1—Stack efficiency curves point out the importance of operating rectifiers as near as possible to full design rating. Efficiency drops off sharply at lower loads.

for most efficient operation it is best to hold the voltage as near 100 percent rating as possible.

Now examine the other curve where voltage is held at 100 percent rating and amperage is lowered. This gives a near flat curve except near the lower ranges where the drop increases. This would indicate that it is possible to operate a unit at from 50 percent up to 100 percent rated amperage without too great a loss in efficiency.

Seasonal Variations Effect Current Output. The ground bed is sensitive to change in soil resistivity. A change of moisture content of the earth will increase or decrease the ground bed resistance. As an example, consider sandy-loam soil with zero percent moisture content. Its resistivity may be more than one megohm per cubic centimeter. Now by adding 30 percent moisture the resistivity falls to about 4000 ohms per cubic centimeter. This is based upon actual test data and not general conditions.

Temperature Affects Output, Too. Ground bed resistance may also be affected by temperature changes. An example from actual tests is cited. Sandy loam soil with 15.2 percent moisture had a resistivity of 7200 ohms per cubic centimeter at 20° C. When the temperature was lowered to —15° C the resistivity became 330,000 ohms per cubic centimeter.

—The End

Here's a Practical Approach to Gas Flow Studies

More than 200 field tests conducted under actual operating flow conditions by Southern Natural Gas Co. are the bases for these calculations.

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MANY DIFFERENT formulas have been presented for determination of flow of gas in pipe lines. All are derived from the basic flow equation. Chief difference in them is in the determination of friction coefficient. Some formulas set a basic friction factor for all conditions; some relate friction factor or transmission factor to diameter and absolute roughness. Others relate transmission factor to Reynolds number. Early formulas did not adjust for deviation from perfect gas laws. It is generally accepted today that such adjustment is necessary.

A standard formula, used with a table of constants for the several variables discussed below, can be handled rapidly in manual operation. Such a formula could be keyed into the operation of any of the basic digital computers, allowing more rapid and complete analysis of today's complicated pipe line networks.

For practical application, based on the tests submitted herein, it is reasonable to conclude transmission factor is not a function of Reynolds number for turbulent flow in the area of normal commercial operation, but that transmission factor is a function of diameter and absolute roughness. It appears that variations of absolute roughness due to varying pipe conditions is of greater significance than pipe diameter. It is urged that a basic absolute roughness factor, such as 0.0007, be agreed upon as being the norm against which pipe line efficiency can be determined. The need for such a norm in the form of a standard formula based on maximum possible efficiency against which actual line performance may be compared is emphasized.

The first attempt to produce a standard formula was made in 1935 when T. W. Johnson and W. B. Berwald[1] presented a joint report on flow of natural gas through high-pressure transmission lines, under the sponsorship of the Bureau of Mines and the Natural Gas department of the American Gas Association, issued as Monograph No. 6 of the Bureau of Mines. Numerous data on gas flow through commercial transmission lines were obtained and analyzed. This was probably the most thorough and comprehensive analysis of flow of gas in pipe lines to that date. Johnson and Berwald concluded that for the larger diameter lines, free from condensates and other foreign materials, and operating under steady flow conditions, the metered rates of delivery agreed more closely with the rates calculated from Weymouth's formula than with those calculated from any of the other formulas; and in almost every test, under these conditions, the volume calculated from Weymouth's formula was within a few percent of the metered delivery. Further experiments, under actual conditions of natural gas transmission, were recommended. This work was later extended by Smith, Miller and Ferguson in 1956.[2]

Analysis of pipe line flow efficiency field test data by the Institute of Gas Technology in 1952 and 1953 disclosed inconsistencies in the data resulting from differences in measuring technique. To satisfy the need for proper evaluation of field measurement procedures, and for development of criteria for judging the validity of field data, a set of preliminary recommendations for efficiency testing was developed in 1954. In May, 1956, a formal procedure for pipe line efficiency testing was presented by R. F. Bukacek and R. T. Ellington.[3]

Currently the American Gas Association, working with the Institute of Gas Technology at Chicago, through its Project NB-13, "Pipe Line Efficiency Flow Standards" is in the process of analyzing an appreciable quantity of test data. These data, provided through the cooperation of a number of pipe line companies, cover field tests of a number of pipe lines and include a wide range of diameters and various flow rates. No conclusions have as yet been published by this committee.

Without anticipating the conclusions of the committee, it is desired to consider certain data, consisting of more than 200 tests made on pipe lines of Southern Natural Gas Company. Certain conclusions were reached upon examination of that data. Tests were made under the supervision of the Operating department of Southern Natural Gas Company.

All Formulas Originate With Basic Flow Equation. Much information is available in the literature on flow of gas in pipe lines. Numerous varying formulas are offered for the practical solution of the problem. They all originate from the basic flow equation, as derived from the general energy equation. The basic derivation of the general flow formula appears in the work of Johnson and Berwald in U. S. Bureau of Mines Monograph No. 6 and will not be repeated here:

The general flow formula:

$$Q = K \frac{T_b}{P_b} \left[\frac{(P_1^2 - P_2^2)\, d^5}{GTLf} \right]^{1/2} \qquad (1)$$

where Q = volume of gas in cubic feet per hour at pressure base P_b and temperature base T_b;
K = numerical constant 1.6156;
T_b = temperature base, defining one cubic foot of gas, degrees F absolute;
P_b = pressure base defining one cubic foot of gas, pounds per square inch absolute;
P_1 = inlet pressure, pounds per square inch, absolute;
P_2 = outlet pressure, pounds per square inch, absolute;
d = internal diameter of pipe, inches;
G = specific gravity of gas (air = 1.000);
T = temperature of flowing gas, degrees F absolute;
L = length of pipe in miles;
f = coefficient of friction.

This gives no recognition to the deviation factor, which is recognized by Smith, Miller and Ferguson[2] in Monograph No. 9 as follows:

$$Q = K \frac{T_b}{P_b} \sqrt{1/f} \sqrt{1/Z} \left[\frac{(P_1^2 - P_2^2)\, d^5}{GTL} \right]^{1/2} \qquad (2)$$

where f = resistance coefficient, dimensionless;
$\sqrt{1/f}$ = transmission factor, dimensionless;
Z = average effective compressibility factor of gas, dimensionless;

It is noted that "f," formerly defined as "coefficient of friction" is now defined "resistance coefficient," and a new term "$\sqrt{1/f}$," defined as "transmission factor" is introduced. This change was made in an effort to establish clear and concise terminology for these terms.

This formula is the basic flow equation from which all other formulas are derived. At this point, theory gives way to laboratory or field test in the evaluation of the "f" term, or the term that will bring the equation in balance. Three basic approaches have been used in the determination of the various formulas proposed: (1) the application of the friction factor, or resistance coefficient as a constant; (2) its application as a function of the diameter of the pipe only; and (3) as a function of the Reynolds number.

Reynolds Number May Not Control. Reynolds observed that at low velocities flow proceeded in a steady straight-line manner, in which it appeared that all of the particles moved parallel to the walls of the tube. As velocities increased, a certain critical change in the character of the flow occurred, and turbulence appeared.

Smith, Miller and Ferguson[2] noted a change in the relationship between the transmission factor and Reynolds number as this critical point was reached. They stated that transmission factor variations, for the experimental data on two-inch diameter pipe, depended on Reynolds numbers only for ranges in Reynolds numbers from 49,900 to 250,000. At Reynolds numbers ranging from 250,000 to approximately 850,000, transmission factors were related to Reynolds numbers, internal radius of the pipe, and the absolute roughness of the internal surface of the pipe. At Reynolds numbers above 850,000, for the pipes considered, transmission factors were constant and independent of Reynolds numbers. They were influenced only by the absolute roughness and the internal diameter of the pipe. For larger diameters, extrapolated data indicated the break between transition and fully rough flow moved to higher Reynolds numbers. Smith, Miller and Ferguson interpreted these three areas of flow as "smooth," "transition," and "fully rough," which compare with Reynolds' observations of "steady" and "turbulent" areas of flow.

How Field Test Results Were Obtained. Over the past several years, a continuing series of careful tests have been carried out on the pipe lines of Southern

SOUTHERN NATURAL GAS COMPANY PIPELINE TESTING PROGRAM
CALCULATION OF REYNOLDS NUMBER, RESISTANCE COEFFICIENT AND TRANSMISSION FACTOR

Test No.	Mcfd @ 14.73#	Internal Dia. Inch.	$P_1^2 - P_2^2$	P Avg.	Elevation Factor	Grav.	Temp. Abs.	Dev.	Length Pipe Mi.	Gas Visc.	Reynolds Number	Resist. Coef.	Trans. Fact.
1	183,332*	23.500	19,934	717	3,896-	.594	518	.890	9.897	7.78	8,060,056	.002363	20.572
2	174,484	23.500	19,111	703	568-	.594	518	.895	11.491	7.75	7,700,598	.002594	19.634
3	174,114	23.500	21,984	687	1,242-	.594	519	.897	12.084	7.72	7,714,309	.002762	19.028
4	181,362	23.500	20,917	670	1,291-	.594	518	.900	11.655	7.70	8,056,314	.002481	20.076
5	173,068	23.500	17,852	663	1,473-	.594	518	.901	10.314	7.68	7,707,890	.002558	19.772
6	181,160	23.500	13,135	650	4,315+	.594	518	.903	11.111	7.67	8,078,613	.002317	20.775
7	137,013	23.500	12,769	726	3,843+	.594	527	.898	10.56	8.00	7,568,245	.002308	20.421
229	118,193	19.313	32,940	961	222-	.594	531	.871	10.124	8.67	5,673,913	.004231	15.374
230	118,193	19.313	24,466	947	1,251-	.594	531	.872	11.651	8.63	5,700,126	.002600	19.611
231	118,193	19.313	26,431	933	1,338-	.594	531	.874	12.279	8.56	5,746,673	.002681	19.313
232	120,120*	19.313	29,512	923	4,914-	.588	531	.878	12.317	8.50	5,822,186	.002531	19.877
233	120,120*	19.313	22,479	908	1,678+	.588	530	.880	11.291	8.45	5,856,793	.002711	19.206

* All volumes are as measured by ammonia tracer except those marked *, in which cases metered flow was used.

FIGURE 1—Typical data sheet from Appendix A, showing some of the 233 tests made by Southern Natural Gas Company.

Natural Gas Company under the supervision of the Operating department. Pipe lines tested consisted of sizes ranging from 10-inch to 24-inch, inclusive. Flow measurement was made by metering where possible, and checked by means of ammonia tracer. Due to the variable distances of orifice measurement from the point of test, the ammonia tracer method was found to give more consistent results. Typical test results are shown in Figure 1.

Ammonia Tracer Measured Flow. Volumes of gas are stated in Mcf per day at a pressure base of 14.73 psia and are as measured by ammonia tracer. Where ammonia tracer measurement was not available, metered flow is used and the values so obtained are set out by an asterisk. The table shows the measured flow, internal diameter of the pipe line, difference between the squares of the initial and terminal absolute pressures, average absolute pressure in test section, gravity of gas, absolute temperature, deviation factor, and gas viscosity.

An adjustment was made for elevation. A solution was also made for Reynolds number, resistance coefficient and transmission factor.

TEST RESULTS POINT OUT CONCLUSIONS

1. Two hundred and thirty-three tests were conducted in actual operation of a large transmission system. Under varying ranges of normal operating conditions, results were obtained from varying lengths of pipe ranging in nominal size from 10 to 24 inches and under pressures ranging from 300 to 1200 pounds per square inch gage.

During this entire series, Reynolds numbers varied from a low of 2,202,511 for one 12-inch pipe to a high of 13,272,727 for one 18-inch pipe. All of the tests showed Reynolds numbers to be in ranges much higher than Reynolds numbers in the "smooth" and "transition" ranges defined by Smith, Miller and Ferguson. They were also well above the Reynolds number which, according to Smith, Miller and Ferguson, define the limit above which the transmission factors are influenced only by the absolute roughness and internal diameter.

TABLE 1

Comparison of Transmission Factors and Absolute Roughness Coefficients By Pipe Sizes From Tests Made By Southern Natural Gas Company

Line	PIPE SIZE, INCHES O.D.	I.D.	Number of Tests	TRANSMISSION FACTORS Minimum	Maximum	Average	Absolute Roughness Coefficient
1	24	23.500	20	19.741	20.933	20.195	0.000777
2	22	21.375	11	19.630	20.943	20.160	0.000721
3	20	19.313	8	16.265	18.818	17.591	0.002596
4	24	23.188	6	17.565	19.803	19.026	0.001503
5	22	21.375	18	19.245	21.320	20.413	0.000624
6	18	17.375	22	18.315	20.528	19.350	0.000935
7	12¾	12.125	4	18.257	19.518	18.893	0.000848
8	20	19.313	16	17.678	19.952	18.921	0.001329
9	24	23.188	6	16.860	20.240	19.207	0.001354
10	14	13.375	1	.....	.....	15.811	0.005518
11	16	15.375	1	.....	.....	18.257	0.001552
12	12¾	12.125	1			16.514	0.003372
13	20	19.313	9	16.566	19.642	18.846	0.001389
14	20	19.313	2	18.474	20.228	19.351	0.001038
15	14	13.375	13	17.413	19.668	18.752	0.001015
16	16	15.438	7	18.788	19.691	19.400	0.000807
17	18	17.375	4	19.830	19.940	19.875	0.000691
18	16	15.438	1			19.245	0.000882
19	18	17.375	4	19.181	19.462	19.355	0.000932
20	16	15.375	9	18.380	20.000	19.211	0.000950
21	12¾	12.250	3	18.898	20.000	19.503	0.000603
22	10¾	10.250	4	18.257	20.000	18.896	0.000716
23	16	15.438	5	18.945	19.745	19.432	0.000792
24	18	17.375	5	18.709	20.024	19.645	0.000789
25	20	19.250	2	17.140	17.321	17.230	0.003509
26	22	21.375	10	16.391	21.063	19.288	0.001191
27	18	17.500	2	18.098	18.257	18.178	0.001848
28	22	21.375	4	17.874	19.563	18.709	0.001663
29	18	17.375	4	18.411	19.121	18.768	0.001307
30	22	21.375	1	.....	.....	19.415	0.001075
31	24	23.390	1			20.000	0.000865
32	24	23.500	4	18.452	18.966	18.688	0.001850
33	18	17.375	17	18.676	20.357	19.706	0.000761
34	20	19.313	8	17.639	19.877	18.620	0.001581

Therefore, if this conclusion can be borne out by further tests, normal pipe line operation need not be concerned with the Reynolds criterion, but only by diameter and by absolute roughness.

2. Plots made of transmission factor against Reynolds number for 16-, 18- and 24-inch diameters from the test data show a broad band of points at each Reynolds number, and no clearly defined relationship between Reynolds number and transmission factor within the test range.

If the influence of Reynolds number is not felt in rough, turbulent flow, but rather if the transmission factor is influenced only by the absolute roughness and internal diameter, then the data should be examined by sizes of pipe, and roughness factors calculated for each pipe size. The formula used by Smith, Miller and Ferguson is their resistance equation (Formula 28, Monograph 9):

$$\sqrt{1/f} = 4 \log \frac{7.4\ r}{k} \qquad (4)$$

where r = internal radius of pipe in inches
k = absolute roughness coefficient.

Results of this examination are tabulated in Table 1.

Tests Show Efficiency Range

Tests were run on:

- Pipe lines in good condition, operating efficiently (Lines 1, 2, 5, 17, 23 and 33).
- Pipe lines known to have contained foreign matter, presumably liquids, at time of tests (Lines 3, 4, 7, 8 and 9).
- Field gathering lines which had operated at poor efficiency—known to have received liquids (Lines 10, 11 and 12).
- Some of the oldest portions of Southern Natural's system, a great part of which consisted of coupled lines (Lines 25, 26, 27, 28, 29 and 30).

A range of absolute roughness factors may be determined to show operating conditions for maximum to poor efficiency—using 0.0007 as the norm for determining this efficiency.

Condition of the pipe line with respect to liquids or other foreign matter, and with respect to age and type of construction (couplings, valves, and cross connections) had a much greater influence on the transmission factor than the pipe diameter or Reynolds criteria.

Standard Formula Needed. It is apparent from the above discussion that it is not possible to specifically express the percent efficiency of a pipe line without a basic norm or standard base of reference. Each gas transmission company rates its pipe lines according to its own formula, assuming friction coefficients based on either Reynolds numbers or pipe diameters, and on roughness coefficients related or not related to diameters. A line that may be rated at high efficiency by one formula will be rated at a low efficiency by another. In fact, by some formulas, a line may be rated over 100 percent efficiency.

It is evident that line efficiency cannot be adequately determined by friction coefficients based on a constant without reference to line size. It also appears that in many actual operating conditions the friction coefficient or transmission factor is independent of Reynolds number. May it be assumed that a practical solution for commercial pipe lines under normal operating conditions is in the area of high Reynolds numbers with transmission factors based on diameters and absolute roughness alone?

Smith, Miller and Ferguson suggest a tentative average absolute roughness of 0.0007, and agree that for fully rough flow the transmission factor is not a function

of Reynolds number. On this basis, transmission factors are calculated for varying pipe diameters in Table 2.

Such transmission factors are not offered as final, but are suggested as probably representative of transmission factors for turbulent flow in areas of high Reynolds numbers. Acceptance of a basic absolute roughness coefficient for pipe of maximum practical smoothness will permit the determination of transmission factors which might be used as standards of maximum line efficiency.

TABLE 2
Transmission Factors For Rough Turbulent Flow Through Pipelines Of Various Diameters

$$\left[\sqrt{1/f} = 4 \log d \div 14.9; \qquad K = 0.0007\right]$$

PIPE SIZE, Inches

O.D.		Wall	I.D.	Transmission Factor
4 1/2	x	3/16	4.125	17.362
6 5/8	x	1/4	6.125	18.048
8 5/8	x	1/4	8.125	18.539
10 3/4	x	1/4	10.250	18.943
12 3/4	x	1/4	12.250	19.253
14	x	1/4	13.500	19.421
16	x	5/16	15.375	19.647
18	x	5/16	17.375	19.860
20	x	11/32	19.3125	20.043
22	x	3/8	21.250	20.209
24	x	13/32	23.1875	20.361
26	x	7/16	25.125	20.500
30	x	7/16	29.125	20.757

Deviation Factor Considered. It has been shown that natural gas does not follow the ideal gas relationship, but that, at high pressures greater volumes of gas may be compressed into a given space than the ideal gas laws indicate. Failure to recognize this deviation in the past has not introduced a material error because of the low pressures at which earlier pipe lines operated. However, with continuing increases in operating pressures, recognition of this deviation or supercompressibility characteristic of the gas becomes more and more important.

This subject has been covered by Dr. George Granger Brown[4] in his paper, "Deviation of Natural Gas From Ideal Gas Laws." Dr. Brown points out that although numerous equations of state have been proposed, the most convenient methods for computing the pressure-volume-temperature relationship of natural gas is by the use of the so-called compressibility factor, which represents the deviation of the gas in question from the ideal gas laws, as expressed by the equation

$$PV = ZNRT \qquad (5)$$

where P = pressure in pounds per square inch absolute
V = volume in cubic feet
Z = the compressibility factor
N = number of pounds mol
R = 10.71 for all gases
T = absolute temperature.

The compressibility factor Z is a dimensionless intensive factor independent of the extent or weight of the gas, and determined by the character of the gas, the temperature, and the pressure. Once Z is known or determined, the calculation of the pressure-temperature-volume relationship may be made with as much ease at high pressure as at low pressure.

According to the theorem of corresponding states, the deviation of an actual gas from the ideal gas law is the same for different gases when at the same corresponding state. The same corresponding states are found at the same fraction of the absolute critical temperature and pressure which are known respectively as

$$\text{Reduced Temperature} \quad T_r = \frac{T}{T_c} \qquad (6)$$

$$\text{Reduced Pressure} \quad P_r = \frac{P}{P_c} \qquad (7)$$

where T_c = the absolute critical temperature
P_c = the absolute critical pressure
T = the absolute temperature at which the gas exists
P = the absolute pressure at which the gas exists
T_r = reduced temperature
P_r = reduced pressure

Critical temperature is defined to be the temperature above which a pure gas cannot be liquefied by pressure alone. Critical pressure is defined to be the pressure below which a pure gas may exist in a gaseous state in equilibrium with its liquid.

Therefore, if the theorem of corresponding states can be applied without appreciable error, all gases would have the same value of Z at the same reduced temperature and pressure, and a plot of Z for methane, as a function of reduced temperature and pressure, can be applied to determine the unknown value of Z for some other gas if we know or can determine the critical temperature and pressure of the second gas.

Dr. Brown presented such a plot for methane and for natural gas which has found wide use in the industry in the determination of compressibility factors.

Based on this chart, deviation factors are determined for each of the various gas mixtures found in the system on which gas tests were made. Characteristics of the gas considered are determined by laboratory analysis. Individual absolute critical temperatures and pressures of each constituent are set down and the pseudo-reduced temperature for the mol-fraction calculated. The arithmetic total of these fractions will give the absolute pseudo-critical temperature and absolute pseudo-critical pressure for the gas mixture considered. From these values the pseudo-reduced temperatures and pseudo-reduced pressures for varying actual temperatures and pressures are determined. From these factors, the deviation factors may be read from the chart.

As Dr. Brown points out, like all correction factors, the value of Z depends upon experimental data for its determination.

Supercompressibility Factor Determined Several Ways. In 1955, the American Gas Association,[5] through PAR Project NX-7, prepared such data based on the specific gravity method of supercompressibility factor determination. Tables of supercompressibility factors F_{pv} for natural gas were issued for nominal temperatures from 0° to 180° F. for specific gravity from 0.554 to 0.750, and for pressures of from 0 to 3000 psig. Separate tables were included for the determination of supercompressibility factors for natural gas containing nitrogen and/or carbon dioxide.

$$\text{By definition} \quad F_{pv} = \sqrt{\frac{NRT}{PV}} \qquad (8)$$

$$\text{From Equation 5} \quad \sqrt{1/Z} = \sqrt{\frac{NRT}{PV}} \qquad (9)$$

$$\text{Therefore,} \quad F_{pv} = \sqrt{1/Z} \qquad (10)$$

In Table 3, a comparison is made between Z factors calculated by the Granger Brown method and F_{pv} factors as taken from the A.G.A. tables. The differences are negligible, and it may be concluded that deviation factors may be determined by either method.

A Proposed Gas Flow Formula. It appears, at least from data available here, that the following conclusions can be drawn:

- For turbulent flow transmission factor is not a function of Reynolds number
- Normal commercial operation will fall within this range
- The transmission factor will be a function of diameters and absolute roughness
- The absolute roughness coefficient for pipe lines in good condition should approximate 0.0007
- The deviation factor may be obtained by the George Granger Brown method or from the A.G.A. tables of deviation
- All of these factors may readily be incorporated in the basic flow equation.

TABLE 3
Comparison of Deviation Factor Z of Westfield Gas Calculated By Granger Brown Method With F_{pv} From AGA Tables

(1)	(2)	(3)	(4)	(5)
Pressure Psig	"Z" at 60° F.	$\frac{1}{Z}$ at 60° F.	$\sqrt{\frac{1}{Z}}$	AGA Tables F_{pv}
100	0.983	1.0173	1.0086	1.0083
200	0.967	1.0341	1.0169	1.0164
300	0.950	1.0526	1.0260	1.0246
400	0.934	1.0707	1.0347	1.0329
500	0.918	1.0893	1.0437	1.0416
600	0.903	1.1074	1.0523	1.0501
700	0.890	1.1236	1.0600	1.0589
800	0.876	1.1416	1.0685	1.0677
900	0.862	1.1601	1.0771	1.0763
1000	0.848	1.1792	1.0859	1.0847
1100	0.837	1.1947	1.0930	1.0933
1200	0.825	1.2129	1.1009	1.1015

Therefore, for a design formula applicable to normal commercial use of pipe lines in good condition the basic flow equation may be used as follows:

Proposed Formula

$$Q = K \frac{T_o}{P_o} \sqrt{1/f} \sqrt{1/Z} \left[\frac{(P_1^2 - P_2^2)\, d^5}{GTL} \right]^{1/2} \qquad (11)$$

For normal use, a constant (K_1) may be determined to include all constant factors, including diameter and transmission factor and a table prepared to give K_1 for each diameter. The equation then becomes:

$$Q = K_1 \left[\frac{P_1^2 - P_2^2}{L} \right]^{1/2} \times \sqrt{1/Z} \qquad (12)$$

At this point consideration is given to the application of the factor $\sqrt{1/Z}$. In most applications, this is taken to be the deviation for the gas at the mean effective pressure between the initial and terminal pressure.

A compressibility factor may be determined which may be applied directly to the pressure.

The modified flow formula then becomes:

$$Q = K_1 \left[\frac{(P_1 \cdot b_1)^2 - (P_2 \cdot b_2)^2}{L} \right]^{1/2} \qquad (13)$$

A plot of deviation factors for a representative gas may then be determined for varying pressures, and a tabulation prepared adjusting the actual pressure to an adjusted pressure recognizing the deviation factor.

In this form, through the use of a table of constants taking into account diameter and transmission factor for each pipe size, and another table giving square of absolute pressures, adjusted for the deviation of a typical gas for varying gage pressures, the formula is readily applied without the use of graphs, charts, logarithms, and without cut and try.

About the Authors

Ivey

Dorough

WILLIAM T. IVEY, M. ASCE chief statistician and planning engineer, has been with Southern Natural Gas Company, its predecessor corporation and associated and subsidiary companies since 1930. He has served as engineer in the design of distribution systems, chief engineer, general superintendent and vice president of gas distribution properties in Mississippi. In his present position Ivey is responsible for forecasting requirements, planning the growth and design of facilities required, determining the size and location of new pipe lines, loops, laterals and compressor stations and economic and operating analysis of the system.

JAMES H. DOROUGH, a graduate of the Georgia School of Technology, has been with the company since 1948 except for 18 months recall to active duty with the U. S. Marine Corps. After two years in Southern Natural's cadet engineer program, Dorough has served as planning engineer in the planning and design of facilities for Southern's system.

REFERENCES

[1] Flow of Natural Gas Through High-Pressure Transmission Lines, by T. W. Johnson and W. B. Berwald, U. S. Department of the Interior, Bureau of Mines, Monograph No. 6, February, 1935.

[2] Flow of Natural Gas Through Experimental Pipe Lines and Transmission Lines, by R. V. Smith, J. S. Miller and J. W. Ferguson, U. S. Department of the Interior, Bureau of Mines, Monograph 9, 1956.

[3] Procedures for Pipe Line Efficiency Testing, by R. F. Bukacek and R. T. Ellington, Transmission Committee, American Gas Association, May, 1956. (PIPE LINE INDUSTRY, July, 1956, p. 16.)

[4] Deviation of Natural Gas from Ideal Gas Laws, by Dr. George Granger Brown, 1943.

[5] Supercompressibility Factors for Natural Gas, American Gas Association, 1955.

[6] Gas Flow Computations, P. M. Biddeson, A.G.A., 1941.

ACKNOWLEDGMENT

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See next page for an explanation of how Southern Natural used the test data . . .

This Is How Southern Natural Used Test Data . . .

Correction for Elevation Change

In areas in which there are material differences in elevation it is necessary to adjust for these differences. Such adjustments have been made in the analysis of test data given in Appendix A. This correction has been made by the application of an adjusting factor, shown here as an adjustment to the differences of the squares of the absolute pressure in Equation 12.

$$Q = K_1\left[\frac{(P_1^2 - P_2^2) - 0.0375\dfrac{G(H_2 - H_1)\ Pavg^2}{Zavg \cdot Tavg}}{L}\right]^{\frac{1}{2}} \times \sqrt{1/Z} \quad (14)$$

where the elevation factor term is

$$\frac{0.0375\ G(H_2 - H_1)\ Pavg^2}{Zavg \cdot Tavg}$$

G = gravity of flowing gas (air = 1.000)
Z = average supercompressibility factor
T = average flowing temperature °F. absolute
P = average flowing pressure psia
H_1 = elevation at inlet of pipe section (feet)
H_2 = elevation at outlet of pipe section (feet)

Calculation for Reynolds Number

$$R = 135.321 \times 10^{-4} \times \frac{QG}{Vd} \quad (15)$$

where Q = Mcfd at 60° F. and 14.73 psia
G = gravity of gas (air = 1.000)
*V = viscosity of gas (lb. per sec. ft.)
d = internal diameter of pipe inches

* V in Appendix A shown times 10^6.

Application of Deviation Factor

Beginning with the proposed formula (Equation 12)

$$Q = K_1\left[\frac{(P_1^2 - P_2^2)}{L}\right]^{\frac{1}{2}} \times \sqrt{1/Z} \quad (12)$$

This formula expresses the deviation as a function of the mean effective pressure between the initial and terminal pressure of the span being considered. This formula may also be expressed

$$Q = K_1\left[\frac{(P_1^2 - P_2^2)\ 1/Z}{L}\right]^{\frac{1}{2}} \quad (16)$$

The literature suggests that

$$1/Z = (1 + JP_M) \quad (17)$$

where JP_M is the average deviation factor at the mean effective pressure and may be expressed as $(1/Z - 1)$ for the pressure considered. P_M, the mean effective pressure, can be equated to P_1 and P_2 as follows.

$$P_M = 2/3\left[\frac{P_1^3 - P_2^3}{P_1^2 - P_2^2}\right] \quad (18)$$

Substituting Equation 17 in Equation 16 gives

$$Q = K_1\left[\frac{(P_1^2 - P_2^2) + JP_M\ (P_1^2 - P_2^2)}{L}\right]^{\frac{1}{2}} \quad (19)$$

Substituting Equation 18 for P_M in Equation 19 reduces to

$$Q = K_1\left[\frac{(P_1^2 - P_2^2) + J\ 2/3\left(\dfrac{P_1^3 - P_2^3}{P_1^2 - P_2^2}\right)(P_1^2 - P_2^2)}{L}\right]^{\frac{1}{2}} \quad (20)$$

Simplifying and grouping

$$Q = K_1\left[\frac{(P_1^2 - P_2^2) + J\ 2/3\ (P_1^3 - P_2^3)}{L}\right]^{\frac{1}{2}} \quad (21)$$

$$Q = K_1\left[\frac{(P_1^2 - P_2^2) + J\ 2/3\ P_1^3 - J\ 2/3\ P_2^3}{L}\right]^{\frac{1}{2}} \quad (22)$$

$$Q = K_1\left[\frac{P_1^2\ (1 + J\ 2/3\ P_1) - P_2^2\ (1 + J\ 2/3\ P_2)}{L}\right]^{\frac{1}{2}} \quad (23)$$

Then, expressing

$$(1 + J\ 2/3\ P_1) = b_1^2 \quad (24)$$

Where b is a factor for the determination of the deviation of the gas at the particular pressure being considered, the formula becomes:

$$Q = K_1\left[\frac{(P_1^2 b_1^2) - (P_2^2 b_2^2)}{L}\right]^{\frac{1}{2}} \quad (25)$$

which formula is formula 13 above mentioned.

Thus, a table may be prepared making the appropriate adjustment for deviation of the gas considered, and relating the square of the absolute pressure adjusted for deviation to the corresponding gage pressure. This table will give factors which can be substituted in the proposed equation which will adjust for deviation.

Verification of Equation 15

The Reynolds number, a dimensionless ratio commonly used to characterize the conditions of fluid flow in circular pipes, is given in the literature as:

$$R = \frac{Du\rho}{\mu} \text{ or } R = \frac{Du}{v} \quad (26)$$

where R = Reynolds number;
D = diameter of pipe;
u = average linear velocity;
ρ = density of fluid;
μ = dynamic viscosity of fluid;
v = kinematic viscosity of fluid (μ/ρ).

The above relationship has been expressed by Biddeson[6] in natural-gas engineering terms as

$$R = 0.011459\frac{QGP_b}{VdT_b}, \quad (27)$$

where Q = rate of flow, cubic feet per hour at a pressure and temperature base of P_b psia, and T_b, °F. abs.;
G = specific gravity of gas (sp. gr. of air = 1.0);
V = viscosity of gas, pounds per second foot;
d = internal diameter of pipe, inches.

The constant in equation (27) adjusts for the mixed units used in the equation.

Equation 15 is obtained by substituting in Equation 27 above the following

$$Q = \frac{1000}{24}Q_1$$

P_b = 14.73 psia
T_b = (60° F. + 460) = 520° abs.

where Q_1 = rate of flow, thousand cubic feet per day (Mcfd) at a pressure and temperature base of 14.73 psia and 60° F. abs.

Equation 27 becomes

$$R = 0.011459 \times \frac{14.73}{520} \times \frac{1000}{24} \times \frac{Q_1 G}{Vd}$$

Then

$$R = 135.321 \times 10^{-4}\ \frac{Q_1 G}{Vd} \quad \text{(Equation 15)}$$

—The End

Know the Facts About Pump Packings and Seals

Here is a complete discussion of construction features, installation, and maintenance tips. All types of packings, glands and mechanical seals for centrifugal pumps are covered in the series.

By HAROLD WOODHOUSE
Dean Hill Pump Company
Indianapolis

A LARGE PIPE LINE system is an impressive spectacle and a giant conglomeration of many of the twentieth century's latest industrial developments. But, like all giants it has its vulnerable spots. One such spot has been the insignificant little item of shaft packing for centrifugal pumps. For instance, the effect of using one kind of packing, aluminum metal foil for light hydrocarbons service was attributed as causing one explosive fire.

The packing and packing boxes of a centrifugal pump seem to be simple elements yet they account for more down time than any other part of the pump. Glands are improperly tightened, packing boxes are not correctly filled, or the wrong packing is used.

This article deals with packing boxes and glands, their use and maintenance.

Figure 1 shows a typical packing box having an integrally machined throat. The throat acts as a backstop for the packing and limits the leakage of liquid in the event of complete packing failure. The clearance between the throat bore and the rotor is a variable according to size of pump but 1/32 inch might be taken as an average figure. The clearance between the gland and the rotor is shown as 0.025 inches which, again, might be taken as an average figure.

Since the gland is not machined to a close fit in the packing box bore, it can be seen that the tightening of one gland bolt will probably cause the gland to "cock" and rub on the sleeve or shaft.

Figure 2 shows a packing box having a separate throat bushing. The use of a separate piece for the throat bushing permits easy replacement if it becomes badly worn. It can be made fairly long to reduce the amount of liquid leakage which may take place if the packing should fail completely.

The throat bushing is generally made with a tongue to fit a groove, both of which, in horizontally split casing pumps, extend only around the lower half to prevent the throat bushing from turning.

Figure 3 shows the standard type of two piece interlocking design, which is not bolted together and, therefore, can be removed from the shaft with maximum facility. Its function is to hold the packing in the packing box under the correct amount of compression to produce the seal required.

Figure 4 shows a "smothering gland" which is used when the pump

Operations Handbook

1 **Packing Boxes and Glands**
2 Packings
3 Mechanical Seals
4 Mechanical Seal Maintenance
5 Packing Maintenance

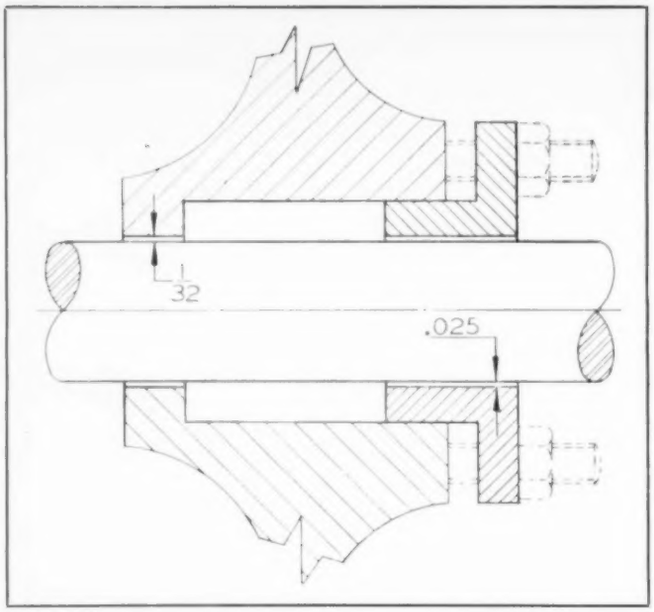


FIGURE 1—Typical packing box has integrally machined throat.

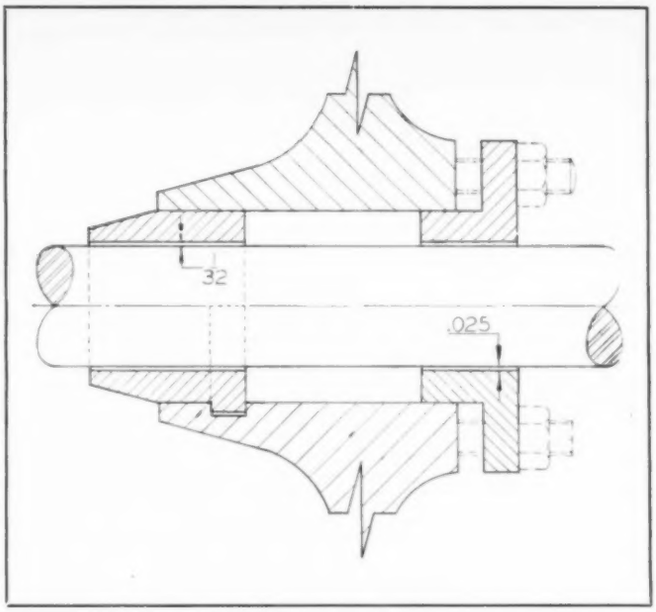


FIGURE 2—Packing box with separate throat bushing.

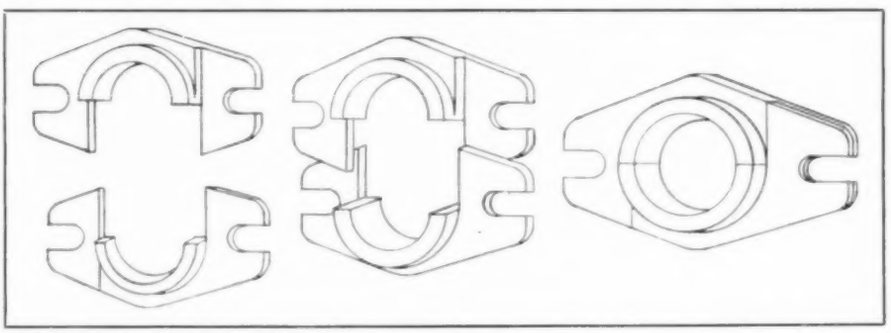


FIGURE 3—Two piece interlocking type gland can be easily removed from the shaft.

is handling liquids where leakage from the gland could result in the release of inflammable gas, noxious fumes or vapors.

The smothering gland has an inside annular space surrounding the rotor to which flexible water supply and drain lines may be connected for flushing away the leakage. Flexibility of the water lines is necessary to permit adjustment of the gland for maintaining correct packing compression. The smothering, or quenching, liquid also serves to form a heat stop on the shaft of hot pumps; it dilutes harmful liquids and absorbs harmful vapors resulting from the leakage of volatile liquids.

Figure 5 shows a smothering gland with auxiliary packing to prevent loss of the quenching liquid along the shaft. The quenching liquid is fed directly to the packing box from a separate, independent source.

Figure 6—On pipe lines, many pumps are handling inflammable liquids. For this reason it is dangerous to allow a gland, of steel, cast iron or other sparking type material, to rub on a shaft or sleeve made of a sparking type material, since it may ignite or explode the leaking vapors. Therefore spark-proof glands must be used. They are made from either solid bronze or brass, or they have spark-proof bronze or brass bushings inserted as shown.

Figure 7—If a pump is handling clear, cool, water (under 180° F.), or other clear liquid with some lubricating qualities and the suction pressure is above atmospheric, but moderate, then the packing boxes may be filled

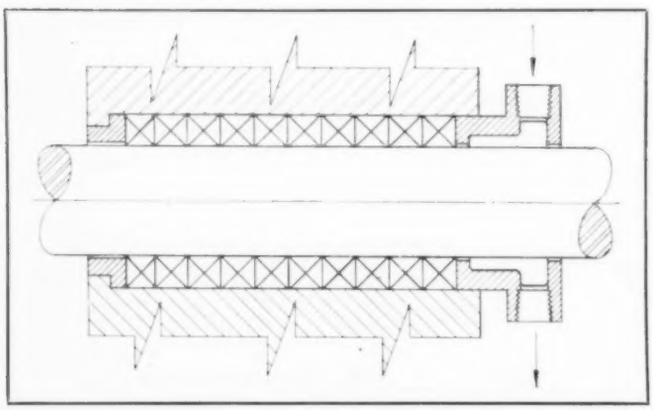


FIGURE 4—"Smothering gland" prevents leakage of inflammable gas, or noxious fumes.

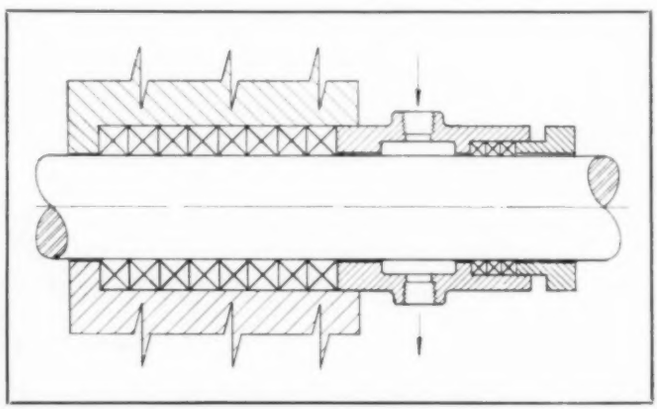


FIGURE 5—"Smothering gland" with auxiliary packing prevents loss of quenching liquid along the shaft.

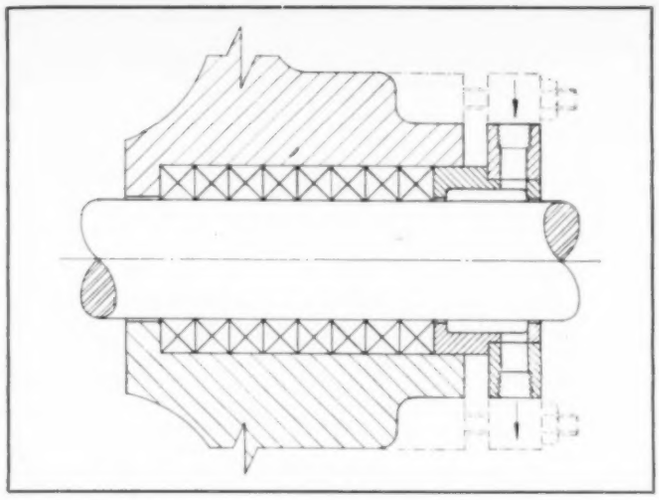


FIGURE 6—Spark-proof bronze or brass bushings prevent explosions.

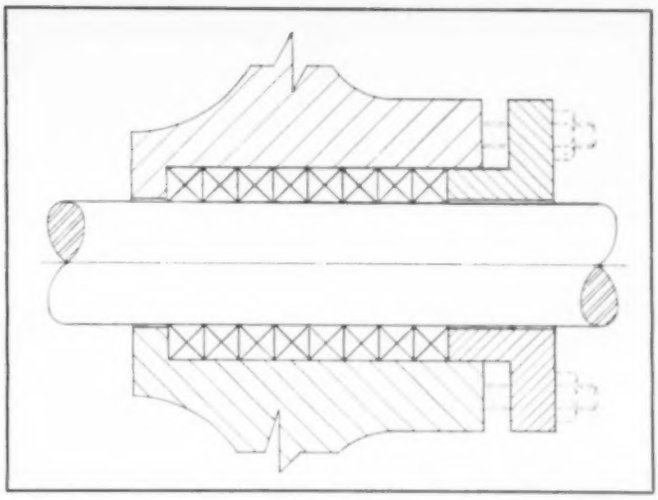


FIGURE 7—Clear liquids allow packing box to be filled solidly with packing.

solidly with packing as shown. It is essential that the packing be loose enough at all times to allow a slight liquid leakage to keep the packing cool and provide a lubricating film around the shaft. Many shaft rotors are damaged at initial starting because an inexperienced operator will have the glands too tight or, if he sees a leakage, he tightens the gland until it stops.

Figure 8—Where there is a suction lift on a pump handling clear water or other clear non-corrosive and relatively inert liquid at a temperature well below its flash point, a lantern (or injection) ring is added to the approximate center of the packing box with a connection to it from the pump discharge volute as shown. This is known as an internal seal. An internal seal has only the one liquid connection on the packing box and for this reason is referred to as "dead-ended." It is also called an "injection box" and the sealing liquid is called "injection liquid."

Figure 9—If the liquid temperature is sufficiently high as to approach the flash point then the packing box may be separately cooled as shown.

Figure 10—Where gritty content in the pumped liquid is small, an internal seal is sometimes used with a strainer in the line. To limit the leakage with an internal seal in the event of gland failure, an orifice may be put in the seal line as shown, but this is more usually done with mechanical seals.

Figure 11—When it is necessary to seal a packing box with a liquid other than that which is being pumped so that the sealing liquid is supplied from a separate source, then it is referred to as an "external seal."

External seals are required if pumping water over 180° F., for volatile, toxic, or corrosive liquids, and slurries. The sealing liquid, also referred to as the quenching or injection liquid, or gland oil, is brought to the packing box, fed into the box at the lantern ring and is piped away on the opposite side or allowed to drain into a drip-rim baseplate. The latter method is commonly done if the liquid is hot water.

This method is also referred to as a "circulating system." The packing box may, or may not, be water cooled.

The compatibility of the sealing liquid used with external seals must be considered in relation to the pumped liquid as some contamination is bound to occur.

Normally, the sealing liquid pressure is maintained about 10 psig above that at the packing box. A steady pressure is desirable as a variable pressure will cause some flexing of the packing and accelerate its wear. Sometimes sealing liquid pressure below pump suction pressure is used where there is a high suction pressure and where leakage of the pumped liquid into the sealing liquid is not objectionable.

When pumping certain non-lubricating type hydrocarbons, solvents

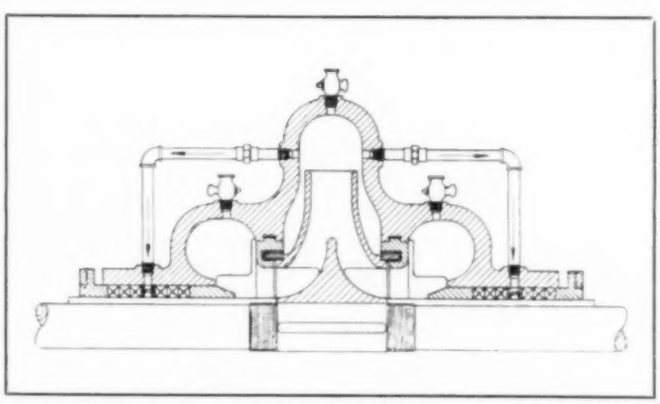


FIGURE 8—Internal seal has a "lantern ring" in center of packing.

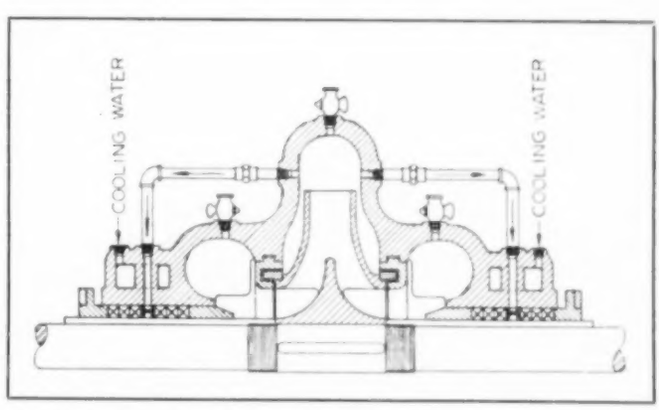


FIGURE 9—Cooling water is added if liquid temperature approaches the flash point.

About the Author

HAROLD W. WOODHOUSE was educated in England where he became associated with Fraser and Chambers, Ltd., manufacturers of turbines and compressors. When he came to this country, he became engineer in charge of radial flow turbine wheels and mixed flow compressor impellers for the De-Laval Steam Turbine Co. Then from 1945 to 1947 he was director of engineering for the Stratos division of Fairchild E & A Corp. After that he became general manager and chief engineer of Power Generators, Ltd., supervising design of high pressure and temperature turbines and centrifugal pumps for the U. S. Navy. For the past six years, he has been chief engineer for the Dean Hill Pump Co. Woodhouse is a member of the API Committee on Mechanical Drive Turbines, Centrifugal Compressors and Pump Manuals.

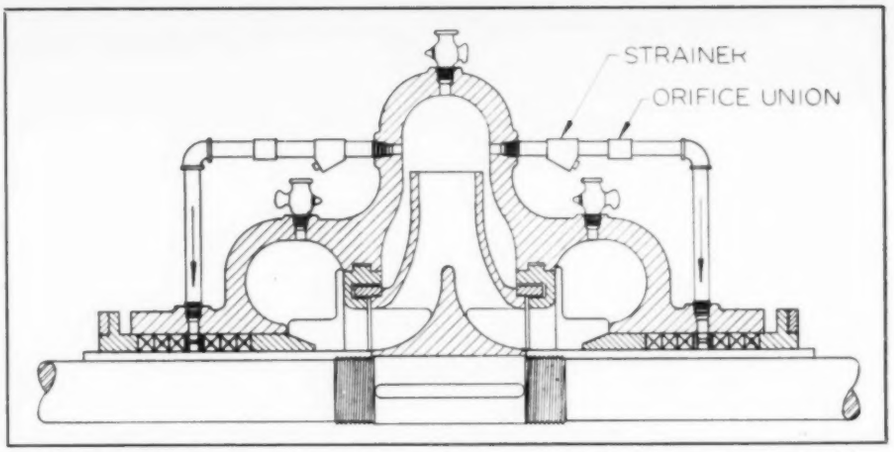


FIGURE 10—If pumped liquid is gritty, an internal seal is used with a strainer in the line.

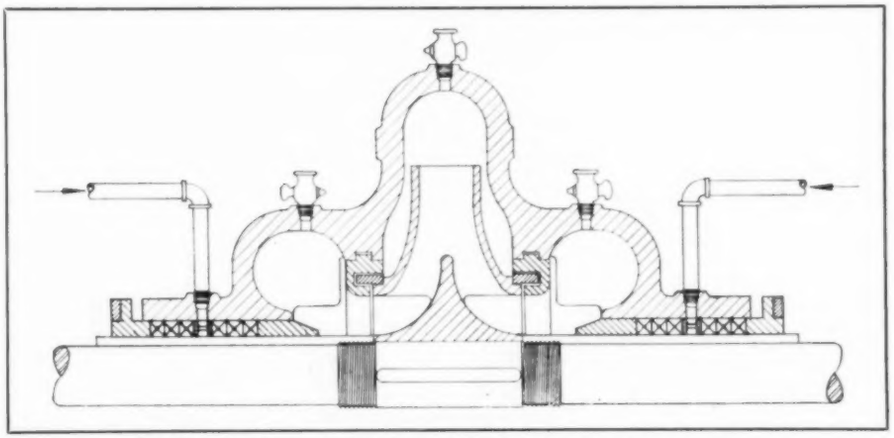


FIGURE 11—External seal uses liquid other than that being pumped.

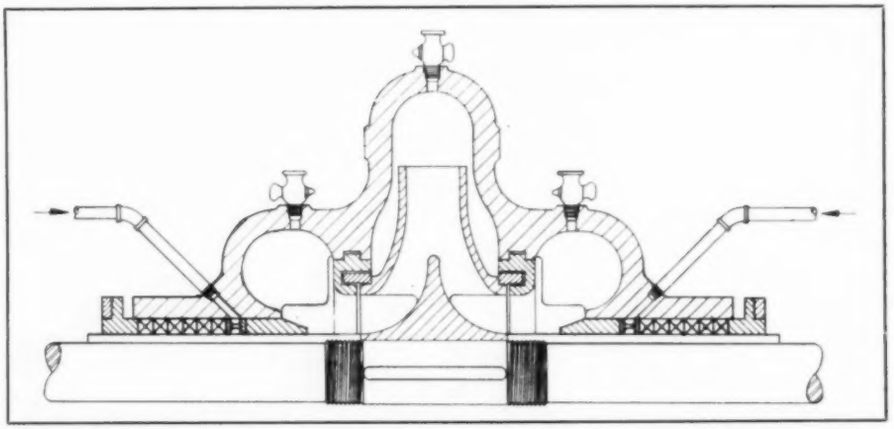


FIGURE 12—External sealing liquid enters at bottom of packing box to prevent abrasive pumping liquid from entering the packing.

and other liquids, a grease lubricator using a non-solvent grease may be tapped into the packing box.

An external seal as shown in Figure 11 may be used on pumps handling slurry or gritty liquids, but it can be seen that there is some danger of the abrasive liquid wearing out the packing between the point of injection of the sealing liquid and the throat bushing and of scoring the throat bushing.

Unless the gritty element is quite slight an arrangement similar to Figure 12 is desirable. This is an external seal but the sealing liquid is fed to a lantern ring at the bottom of the box so that there is no packing between it and the abrasive liquid. The lantern ring, in this instance, should have a close clearance, about 0.025 inch diametral, over the shaft or sleeve to minimize the sealing liquid leakage. The packing box may, or may not, be furnished with an additional lantern ring as shown, depending on the temperature and type of liquid being handled by the pump —if furnished, it may be a "dead-ended" or "circulating" arrangement.

Where two or more condensate pumps are connected to the same condenser, the sealing water connections for the internal seals are taken from the combined condensate discharge pipe. This is essential in order to have the packing boxes of both pumps water sealed even when one of the pumps is idle. Valves fitted on the suction side of condensate pumps frequently have their valve stem packing boxes water sealed by a connection from the combined condensate pump discharge pipe as leaky valve stem packing can result in a material reduction in vacuum.

Part 2 will appear in the July PIPE LINE INDUSTRY.

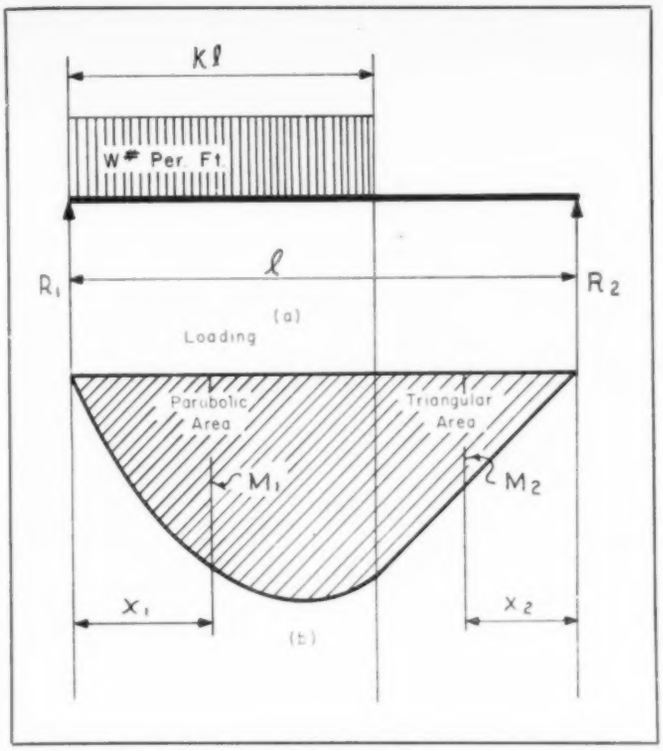


FIGURE 1—Bending moment diagram of simple beam acting under uniform load.

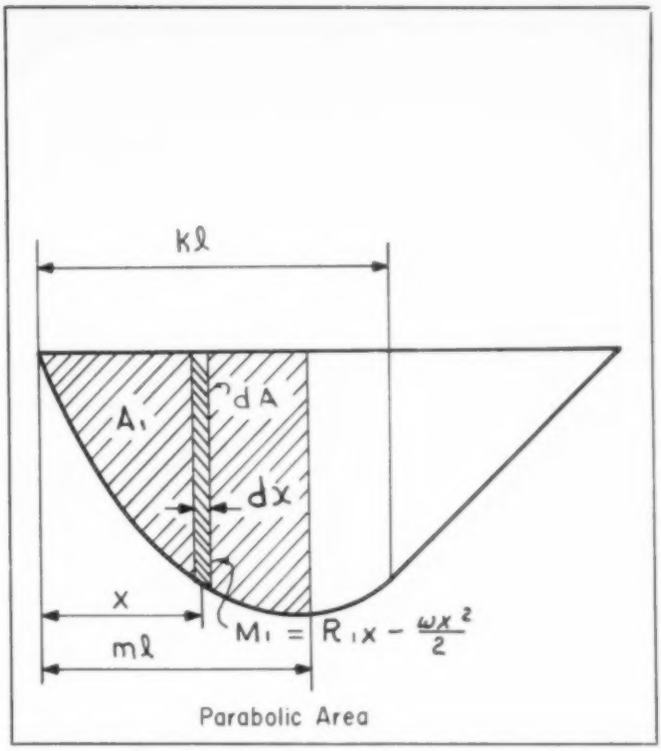


FIGURE 2—Parabolic area of simple beam acting under uniform load.

Find Beam Deflections by Easy Methods

Here's how to solve deflection problems for simple beams without using traditionally tedious algebraic methods.

By CHARLES H. FORK
The Ralph M. Parsons Company
Los Angeles

THE FUNDAMENTAL principles of Moment Areas provides a useful method for solving deflections, both in angular and linear direction. There is, however, a vast amount of labor involved in making a solution, except for the most elementary problems. The necessary arithmetical and algebraic operations for calculating Moment Areas and their centers of gravity are long and tedious. Many cases require the use of Calculus. Needless to say, this discourages a more general use of these important principles of the structural engineer. It is possible, however, to construct influence lines from these principles to enable one to solve deflections quickly and easily. Also, by their use the expressions for deflections may be shortened, making them less cumbersome for use in algebraic operations: for example, the expression

$$d = \frac{wx}{24EIl}\left[a^2(2l-a)^2 - 2ax^2(2l-a) + lx^3\right]$$

expresses the deflection at any point under load, for a partially uniformly loaded, simple beam. By the use of influence lines the expression may be simply written:

$$d = \frac{Fwl^3}{EI}$$

Equating deflections for making a solution then becomes a simple algebraic process. A convenient method for solving deflections provides the structural engineer with a powerful tool for solving the statically indeterminate elements in continuous structures.

The fundamental Principles of Moment Areas were originally developed and later extended to what is now known as the Conjugate Beam Method. This latter method was chosen as the basis for this work.

One of the principal features of the Conjugate Beam Method is the use of an additional beam, in which the loading is the bending moment diagram of the given

PART 1

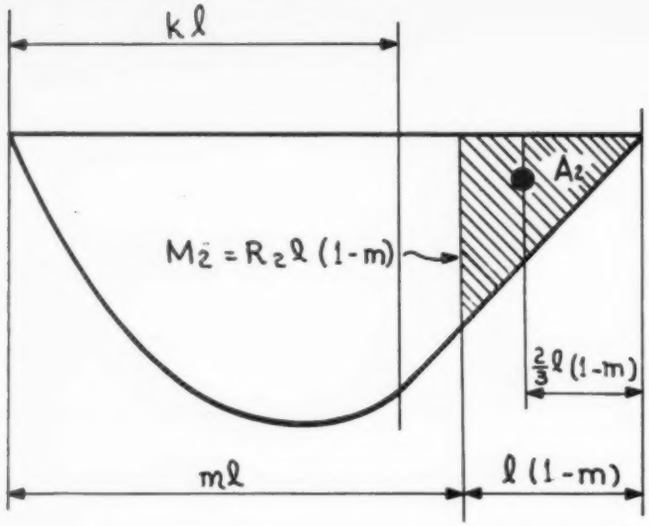


FIGURE 3—Triangular area of simple beam acting under uniform load.

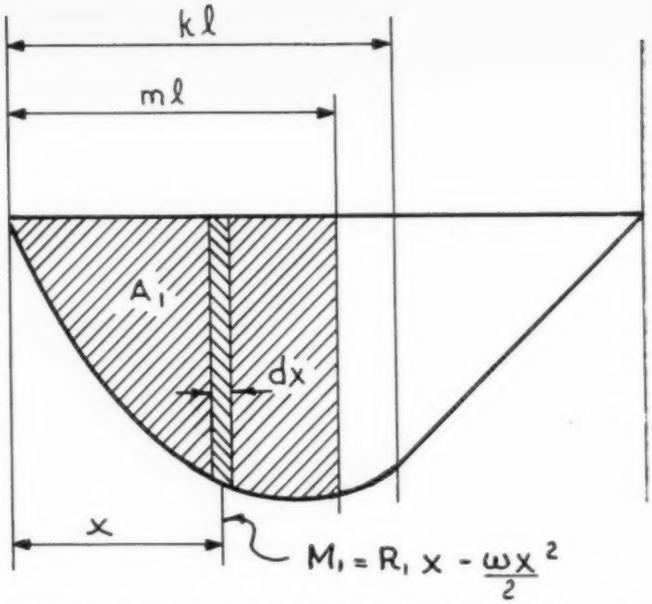


FIGURE 4—Center of gravity of parabolic area for simple beam acting under uniform load.

beam. The Bending Moments in this beam are equal to or proportional to the deflections of the given beam. The location of the supports for the Conjugate Beam must be so chosen that where the deflections or the slopes of the given beam have definite values, the Moment and the shear of the Conjugate Beam must be made to assume those definite values. For example, at points where the deflection of the given beam is zero, the Moment in the Conjugate Beam must be made zero, also where the slope of the given beam is zero, the shear in the Conjugate Beam must be made zero.

Area of Moment Diagram—The moment area for any condition of uniform loading varying from no load to a fully loaded span can be easily computed by referring to Table 1. The center of gravity can be obtained from Table 2. These tables were developed in the following manner:

Consider a simple beam loaded uniformly for a distance k*l* from the left support as shown in Figure 1a.

The reactions of the given beam are:

$$R_1 = wl \times k\left(1 - \frac{k}{2}\right)$$

$$R_2 = wl \times \frac{k^2}{2}$$

The bending moment at any point between k*l* and the left support equals:

$$M_1 = R_1x_1 - \frac{wx_1^2}{2}$$

The bending moment at any point between k*l* and the right support—$M_2 = R_2x_2$. If bending moments are plotted, a diagram is obtained as shown in Figure 1b.

To determine the parabolic moment area between m*l* and the left support in Figure 2, first find the differential area.

$$dA_1 = R_1xdx - \frac{wx^2dx}{2}$$

The total area =

$$\int dA_1 = \int_0^{ml} R_1xdx - \int_0^{ml} \frac{wx^2dx}{2}$$

TABLE 1
Values of C_1 for Area of Parabola

	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	k/m
	.00031	.00073	.0011	.00143	.0017	.0019	.0021	.00223	.0023	.00234	.1
.1	.0020	.00226	.00377	.00507	.0062	.0071	.0078	.00826	.00857	.00867	.2
.2	.0016	.0064	.00697	.0099	.0124	.0144	.0160	.0171	.0178	.018	.3
.3	.0012	.0049	.0110	.0149	.0193	.0229	.0257	.02773	.0289	.0294	.4
.4	.0009	.0036	.0081	.0144	.0261	.0317	.0361	.03916	.0410	.0417	.5
.5	.00063	.0025	.0056	.0100	.0156	.0396	.0460	.0504	.0531	.054	.6
.6	.0004	.0016	.0036	.0064	.0100	.0144	.0544	.0604	.0641	.0653	.7
.7	.00023	.0009	.0020	.0036	.0056	.0081	.0110	.0683	.0731	.0747	.8
.8	.0001	.0004	.0009	.0016	.0025	.0036	.0049	.0064	.0790	.0810	.9
.9	.00003	.0001	.00023	.0004	.00063	.0009	.0012	.0016	.0020	.0833	1.0
1.0	0	0	0	0	0	0	0	0	0	0	
m/k	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	

VALUES OF C_2 FOR AREA OF TRIANGLE

Use values above zigzag line for parabolic areas.
Use values below zigzag line for triangular areas.

TABLE 2
Values of n for Center of Gravity of Parabola

m\k	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	k/m
.1	.0623	.0648	.0654	.0657	.0658	.0659	.0660	.0661	.0661	.0661	.1
.2		.1235	.1275	.1290	.1297	.1302	.1305	.1306	.1307	.1308	.2
.3			.1840	.1890	.1910	.1920	.1930	.1934	.1937	.1938	.3
.4				.2430	.2480	.2510	.2530	.2540	.2540	.2540	.4
.5					.3000	.3060	.3090	.3110	.3122	.3125	.5
.6						.3540	.3610	.3640	.3660	.3670	.6
.7							.4060	.4120	.4150	.4160	.7
.8								.4500	.4560	.4570	.8
.9									.4850	.4875	.9
1.0										.5000	1.0

Integrating between the limits of ml and o =

$$A_1 = \int_o^{ml} \left[\frac{R_1 x^2}{2} - \frac{wx^3}{6} \right]. \text{ When } x = ml,\ A_1 = \frac{R_1 m^2 l^2}{2} - \frac{wm^3 l^3}{6}$$

Substituting for R_1—

$$A_1 = wl \times \left(1 - \frac{k}{2} \right) \left(\frac{m^2 l^2}{2} - \frac{wm^3 l^3}{6} \right)$$

$$\text{or } A_1 = wl^3 \times m^2 \left(\frac{k}{2} - \frac{k^2}{4} - \frac{m}{6} \right) \quad \text{. . . Equation 1}$$

This is the moment area of the parabolic portion between ml and the left support. When m and k equals 1.0, then ml and kl equals l and $A_1 = \frac{1wl^3}{12}$

Let C_1 denote the coefficient in Equation 1.

$$C_1 = m^2 \left(\frac{k}{2} - \frac{k^2}{4} - \frac{m}{6} \right), \text{ then } A_1 = C_1 wl^3 \quad \text{. . . Equation 2}$$

Values of C_1, computed for values of k and m varying from 0 to 1.0, are shown in Table 1.

The moment area of the triangular portion (Figure 3) is found in a similar manner.

$$R_2 = wl \times \frac{k^2}{2},\ M_2 = R_2 l\ (1 - m)$$

Substituting for R_2, $M_2 = \frac{wl^3 k^2\ (1 - m)}{2}$ which is the bending moment at any point to the right of the load.

The moment area of the triangle between ml and the right support is:

$$A_2 = \frac{wl^3 k^2\ (1 - m)}{2} \cdot \frac{l\ (1 - m)}{2} \text{ or } A_2 = \frac{wl^3 k^2\ (1 - m)^2}{4}$$

. . . Equation 3

When m and k = 1.0, then ml and kl = l and $A_2 = 0$. Let C_2 denote the coefficient in Equation 3, then $A_2 = C_2 wl^3$.

. . . Equation 4

Values of C_2 are also computed and found in Table 1.

Center of gravity—To determine the center of gravity of the parabolic moment area in Figure 4, first determine the statical moment of the differential moment area about the left support.

$$dM = R_1 x^2 dx - \frac{wx^3}{2} dx$$

Integrating between the limits of ml and o:

$$\int dM = \int_o^{ml} R_1 x^2 dx - \int_o^{ml} \frac{wx^3}{2} dx$$

$$M = \int_o^{ml} \left[\frac{R_1 x^3}{3} - \frac{wx^4}{8} \right]$$

When x = ml and substituting for R_1

$$M = wl^4 m^3 \left(\frac{k}{3} - \frac{k^2}{6} - \frac{m}{8} \right) = \text{statical moment}$$

About the Author

CHARLES R. FORK is a supervisory structural engineer for The Ralph M. Parsons Co. He was raised in northwestern Ohio, and received his degree in civil engineering in 1912 from Ohio Northern University. Following graduation, he continued his engineering studies in advanced structural mechanics and mathematics at the Universities of Michigan and California. Fork has compiled a book, "Structural Design Data," which is an extensive discussion on the deflection of beams, and has also developed and graphed numerous useful equations for convenient practical use. During World War II he taught several war training courses in Structural Design for the University of California. Fork is a registered civil and structural engineer in California, and is a member of the Structural Engineers Association of Southern California. His principal hobby is the study of mathematics.

The center of gravity = $\frac{\text{Statical moment}}{\text{area}}$

$$= \frac{wl^4 m^3 \left(\frac{k}{3} - \frac{k^2}{6} - \frac{m}{8} \right)}{wl^3 m^2 \left(\frac{k}{2} - \frac{k^2}{4} - \frac{m}{6} \right)} = l \frac{m \left(\frac{k}{3} - \frac{k^2}{6} - \frac{m}{8} \right)}{\left(\frac{k}{2} - \frac{k^2}{4} - \frac{m}{6} \right)}$$

. . . Equation 5

Let n denote the coefficient in Equation 5 then the center of gravity = nl. Values of n were computed for values of k and m varying from 0 to 1.0 and are found in Table 2.

Example: Determine the total moment area for the bending moment diagram in Figure 6 when k = 0.8 and m = 0.8.

From Equation 2—$A_1 = C_1 wl^3$.

From Table 1, at k = .8 and m = .8, C_1 = .0683.

Then A_1 = .0683 wl^3.

Triangular area: $A_2 = C_2 wl^3$.

From Table 1, at k = .8 and m = .8, C_2 = .0064.

Then A_2 = .0064 wl^3.

Total Area = .0683 wl^3 + .0064 wl^3 = .0767 wl^3.

Center of gravity of parabolic area = .45l from Table 2.

Example: Determine a part of the parabolic and triangular moment-areas as shown shaded in Figure 7.

ml—Measures the portion of the moment-areas under consideration.

Parabola:

When k = .8 and m = .4, from Table 1—C_1 = .02773.

Then A_1 = 0.2773 wl^3.

Triangle:

When k = .8 and m = .9 from Table 1—$C_2 = .0016$.

Then $A_2 = .0016\ wl^3$.

Deflection at Any Point—The deflection of a simple beam at any point under uniform load can easily be computed by referring to Table 3. This table was developed in the following manner:

The bending moment at any point between *left* support and k (Figure 8c) is determined as follows: First find the reactions as shown in Figure 8a.

To find the Conjugate Beam reaction $\overset{*}{R}_1$, take the moments about $\overset{*}{R}_2$

$$\overset{*}{R}_1 l - C_1 w l^3 (1 - n) - C_2 w l^3 \cdot \frac{2}{3} l (1 - k) = 0$$

$$\overset{*}{R}_1 = w l^3 \left[C_1 (1 - n) + C_2 \cdot \frac{2}{3} (1 - k) \right] \quad \text{... Equation 6}$$

To find the reaction $\overset{*}{R}_2$, take the moments about $\overset{*}{R}_1$

$$\overset{*}{R}_2 l - C_1 w l^3 \cdot nl - C_2 w l^3 \cdot \frac{1}{3} l (1 + 2k) = 0$$

$$\overset{*}{R}_2 = w l^3 \left[C_1 n + C_2 \cdot \frac{1}{3} (1 + 2k) \right] \quad \text{... Equation 7}$$

Let the coefficients of wl^3 in equations 6 and 7 be denoted by D_1 and D_2 respectively, and multiply wl^3 by the square of 12 reducing to inch units, that is,

$$D_1 = 144 \left[C_1 (1 - n) + C_2 \cdot \frac{2}{3} (1 - k) \right]$$

$$D_2 = 144 \left[C_1 n + C_2 \cdot \frac{1}{3} (1 + 2k) \right]$$

Then $\overset{*}{R}_1 = D_1 w l^3$ and $\overset{*}{R}_2 = D_2 w l^3$

Dividing by the flexural modulus EI gives the angular rotation at each end of the beam.

$$\theta_1 = \frac{D_1 w l^3}{EI} \text{ and } \theta_2 = \frac{D_2 w l^3}{EI}$$

The bending moments as shown in Figure 8c may now be expressed as follows:

$$\overset{*}{M}_1 = D_1 w l^3 \cdot ml - C_1 w l^3 \cdot l (m - n)$$

$$\text{or, } \overset{*}{M}_1 = w l^4 [D_1 m - C_1 (m - n)] \quad \text{... Equation 8}$$

The bending moment at any point between the *right* support and kl (Figure 8d) may be expressed as follows:

$$\overset{*}{M}_2 = D_2 w l^3 \cdot l (1 - m) - C_2 w l^3 \cdot \frac{1}{3} l (1 - m)$$

$$\text{or, } \overset{*}{M}_2 = w l^4 \left[D_2 (1 - m) - C_2 \cdot \frac{1}{3} (1 - m) \right] \quad \text{... Equation 9}$$

Let the coefficients of wl^4 in Equations 8 and 9 be denoted by F_1 and F_2, respectively; also multiply wl^4 by the cube of 12, thus reducing to inch units, that is,

$$F_1 = 1728 \left[\frac{D_1}{144} \cdot m - C_1 (m - n) \right]$$

$$F_2 = 1728 \left[\frac{D_2}{144} (1 - m) - C_2 \cdot \frac{1}{3} (1 - m) \right]$$

Then $\overset{*}{M}_1 = F_1 w l^4$ and $\overset{*}{M}_2 = F_2 w l^4$ and from fundamental principles: $d = \frac{\overset{*}{M}}{EI}$

$$\text{Therefore: } d_1 = \frac{F_1 w l^4}{EI} \text{ and } d_2 = \frac{F_2 w l^4}{EI} \quad \text{... Equation 10}$$

Values of F_1 and F_2 have been calculated for values of k and m, varying from 0 to 1.0 and are found in Table 3. F_1 and F_2 are denoted in the table by F. The

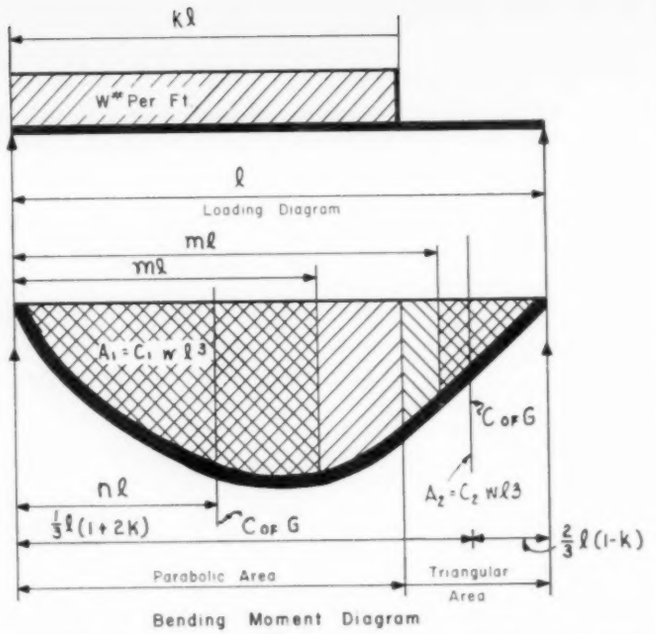


FIGURE 5—Bending moment and loading diagram of simple beam acting under uniform load.

FIGURE 6

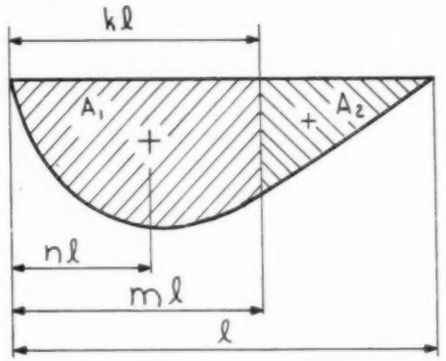
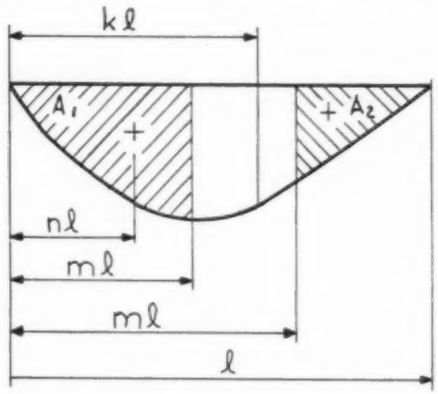


FIGURE 7



value of "kl" measures the length of the load, and "ml" locates the position of the desired deflection. Values of D_1 and D_2 are shown in Table 3. Values of C_1 and C_2, coefficients for the parabolic and triangular areas respectively, have been taken from Table 1. Values of "n" coefficient for the center of gravity of the parabolic area

TABLE 3

Values of D_1 and D_2 Coefficients for Angular Rotation at Supports

k	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
D_1	.215	.776	1.55	2.45	3.38	4.25	4.98	5.53	5.88	6.0
D_2	.108	.469	1.03	1.76	2.63	3.53	4.45	5.23	5.78	6.0

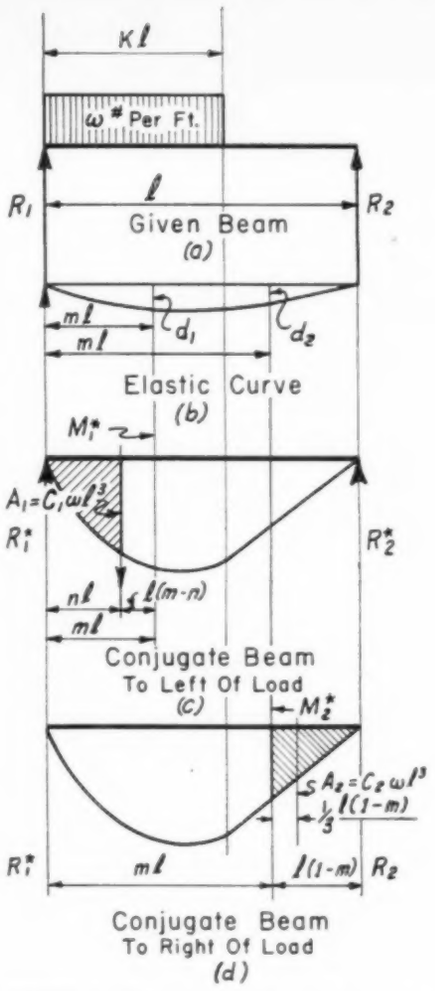


FIGURE 8—Given and Conjugate beam diagrams of a simple beam acting under uniform load.

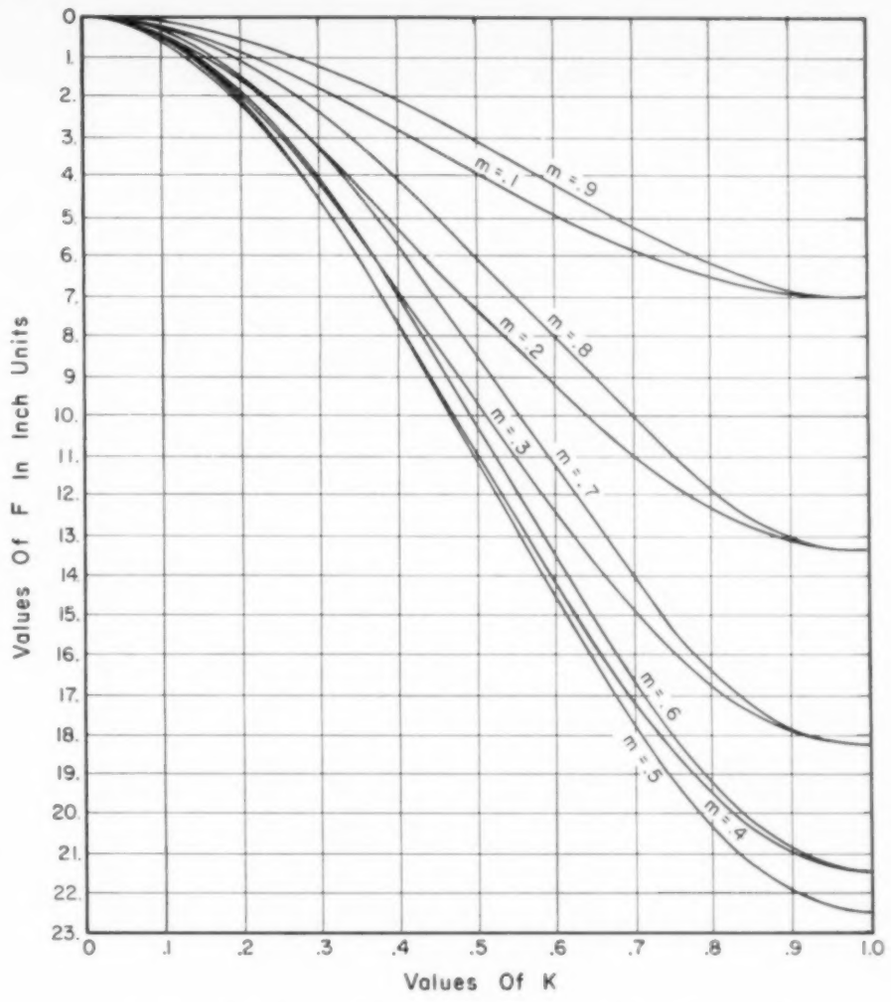


FIGURE 9—Deflection coefficients for simple beam under uniform load.

have also been taken from Table 2. Values of F in Table 4 are also plotted in Figure 9. These curves represent influence lines for the deflection as the load moves over the span.

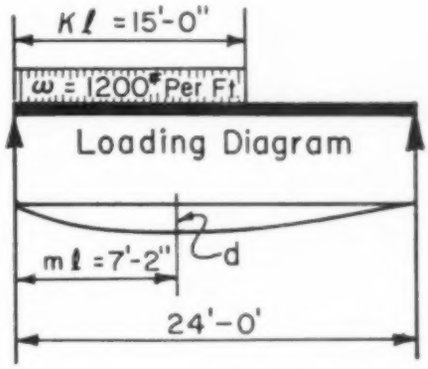
Example: Determine the deflection of a beam 7'-2" from the left support, when the beam is loaded as shown in Figure 7. E = 30,000,000 and I = 441.8.

TABLE 4
Table Values of F, Deflection Coefficients for Uniform Load

m \ k	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
.0	0	0	0	0	0	0	0	0	0	0
.1	.24	.92	1.80	2.85	3.95	4.97	5.84	6.52	6.92	6.99
.2	.41	1.55	3.26	5.26	7.34	9.31	10.98	12.32	13.09	13.36
.3	.51	1.97	4.21	6.98	9.82	12.57	14.94	16.81	17.92	18.30
.4	.55	2.12	4.60	7.72	11.12	14.40	17.30	19.61	20.95	21.43
.5	.53	2.09	4.55	7.70	11.22	14.78	17.93	20.47	21.98	22.50
.6	.47	1.88	4.16	7.00	10.30	13.67	18.62	19.35	20.88	21.43
.7	.39	1.53	3.35	5.73	8.48	11.33	14.15	16.50	17.84	18.30
.8	.27	1.08	2.36	4.05	6.01	8.07	10.10	11.90	13.02	13.36
.9	.12	.55	1.22	2.09	3.11	4.19	5.26	6.17	6.89	6.00
1.0	0	0	0	0	0	0	0	0	0	0

Note: Coefficients "F" are in inch units. Divide by 1728 for foot units.

FIGURE 10



$$k = \frac{15'\text{-}0''}{24'\text{-}0''} = .625 \qquad m = \frac{7'\text{-}2''}{24'\text{-}0''} = .3$$

Then from the chart, F = 13.2 and $d = \frac{Fwl^4}{EI}$

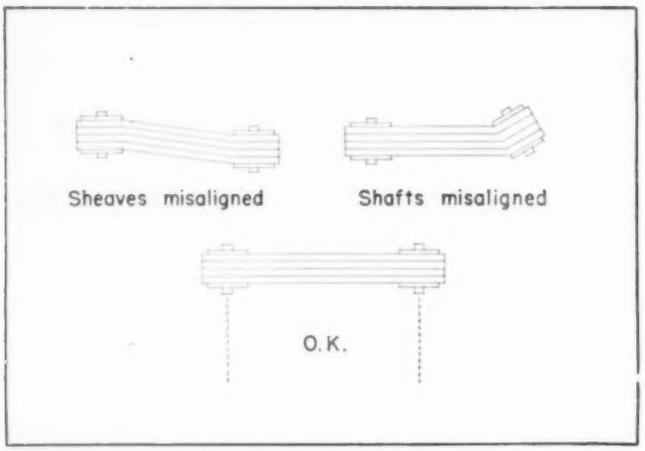
$$d = \frac{13.2 \times 1200\# \times 24^4}{30{,}000{,}000 \times 441.8} = .396''$$

ACKNOWLEDGMENT

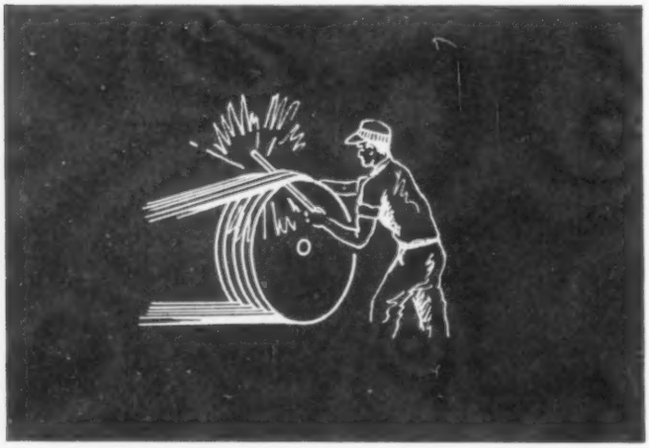
From a privately circulated book by Charles H. Fork entitled "Structural Design Data on Deflection of Beams" upon which the author holds the copyright.

Part 2 will appear in an early issue of Pipe Line Industry

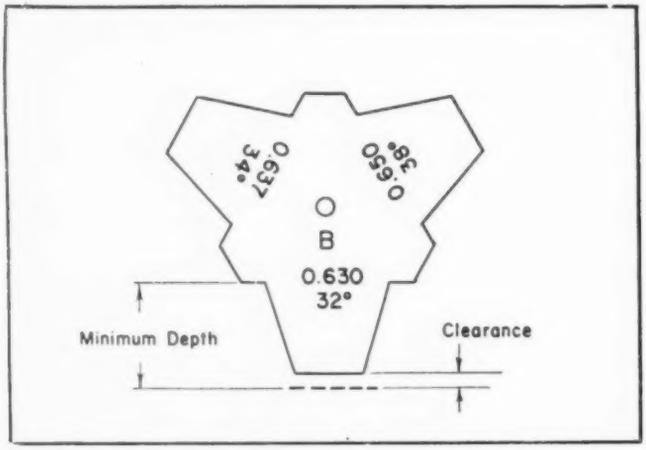
How to Get Longer Life From V-Belts



WATCH THIS Here are two common faults that contribute to short life and poor service from V-belt drives. Make certain that sheaves are lined up properly and that shafts are reasonably parallel. Keeping shafts parallel is more important.



DON'T DO THIS Never pry belts over a sheave. Instead, loosen the take-up. V-belts are elastic but they are not rubber bands. Forcing a belt over groove can break tensile cords making it impossible for belt to carry its share of load.



THIS WILL HELP A simple template well marked will enable the operator to check the wear on the sheaves quickly and accurately. Wear is observed by seating template squarely in the groove and sighting between the sides.

Proper drive setup and alignment are first steps. Periodic inspection, cleaning and checking of sheaves will reduce maintenance to a minimum.

By W. S. WORLEY
The Gates Rubber Company, Denver

More and more V-belt drives are being used to transmit power to pumps and auxiliaries. Characteristically, a V-belt drive requires surprisingly little care and maintenance. An understanding of the fundamentals of how a V-belt operates in the sheave groove, and a knowledge of the stresses to which its various components are subjected while transmitting power, enables an operator to: (1) Identify and correct the troubles which infrequently arise, and (2) realize long, trouble-free service for which the drive was designed.

SETTING UP THE DRIVE

Use a matched set of belts of the same manufacture. Of primary importance to optimum performance and long belt life is use of a matched set of belts of the same manufacture. Do not try to make up a set of belts of different manufacture or of some new and some old belts. A new belt, when placed on a drive with old belts that are worn, may take more than its share of the load. It will be shorter and probably will ride higher in the grooves.

If belts of different manufacture are used, there is a good chance that pitch line locations will not be the same for each belt. Differential driving will result. Possibly the strain constants of the belts may be different. This will result in different amounts of creep and, again, in differential driving.

Clean the sheaves. Clean oil and grease from the sheaves. Remove rust and burrs. Since the belts operate by friction, anything which tends to reduce the coefficient of friction between the belts and the sheaves can mean that higher belt tensions are required to handle the load.

The V-belt wedging effect multiplies the normal force produced by belt tension to the point that belt dressings are not required on V-belt drives. In fact, such dressings can do more harm than good. Some dressings tend to break down the rubber in the V-belts, and also to pick up dirt and sand to which pump drives are exposed. As the belt moves with respect to the sheaves, the sand acts as an excellent lapping compound which quickly wears down the groove sidewalls.

Align the drive. Make sure that the sheaves are lined up properly and that shafts are reasonably parallel. Of

these two suggestions, keeping the shafts reasonably parallel is the more important. When shafts are not parallel, the belts will be progressively tighter toward one side of the drive.

This does not mean that it is necessary to use a transit to set up V-belt drives. An ordinary steel tape, intelligently used, can insure that the shafts are reasonably parallel. The sheaves can be aligned simply by sighting along the edge of one sheave to the other, or by stretching a string from the edge of one sheave to the edge of the other.

Install the belts. When installing V-belts, slack off on the take-up so that the belts can be put on without forcing. Although V-belts are elastic, they are not rubber bands. Forcing a belt over the groove can result in breaking the tensile cords in the belt. The belt will then be unable to carry its share of the load, forcing other belts in the set to carry more than their share.

Take up the slack until only a slight bow appears in the slack side of the belts when operating. If the belts slip, tighten them slightly. If they appear mismatched, but have the right range of matching numbers, tighten a little more, and let the drive operate for a while.

After the drive has been installed and has operated for a day or so to give the belts a chance to seat themselves properly in the grooves, retighten the drive and check alignment and parallelism of the shafts.

MAINTAINING THE DRIVE

Once the belts have been installed and the drive has been set up, only a minimum of maintenance will be required—and that maintenance will consist primarily of preventive inspections.

Inspect the drive occasionally. The operator occasionally will want to check to see that the drive is up to speed, that the belts are clean and free from oil and grease, are not rubbing against a belt guard or other obstruction, appear reasonably matched and are in good alignment. He will want to see that the shafts are parallel and are all operating properly. If malfunctions are noted, the operator will want to determine the trouble and correct it.

Pump speed should be checked against engine speed to determine if the drive is slipping. If so, a take-up should be made. If the belts are greasy and oil-soaked, they should be cleaned with a gasoline-soaked rag and steps taken to prevent this from recurring. If this can not be prevented, then oil-resistant belts should be installed.

Check sheave grooves before replacing a belt. After the first belt or so has failed, continue to operate the drive—retensioning the remaining belts if necessary—until a replacement set has been secured and it is convenient to shut the drive down and make the replacement. When a set of replacement belts is indicated a careful check of the sheave grooves should be made so that a new sheave can be ordered at the same time if necessary.

A template will prove very useful in checking the sheaves. In using such a template, the proper stub (which is shorter than the minimum depth) to fit the angle of the groove is found by experimenting. Wear is observed by seating the template squarely in the groove and sighting between the sides of the template and the sides of the groove.

Groove wear of about $\frac{1}{64}$ to $\frac{1}{32}$-inch probably will not seriously affect the service of the drive. When the wear is about $\frac{1}{16}$-inch, it probably will pay to replace or regroove the sheave. In extreme cases, the shoulder is so pronounced that a new belt simply rides on the shoulder, even though the old belts, which wore in the shoulder, seemed to fit well enough. There are obvious advantages in checking for this condition before putting on a replacement set of belts.

Grooves in a sheave may not always wear down uniformly. When checking for wear, it is good practice to check for uniformity of the grooves with a template. If the template does not fit each groove similarly within about $\frac{1}{64}$-inch at the apparent top width, there may be enough differential driving so that regrooving or replacing the sheave will pay good dividends in longer belt service.

No magic necessary. On occasions when inspection shows that a problem exists, common sense usually will suggest the right procedures. For example, a matched set of belts has been operating a few days and one belt seems to be longer than the others. The sheave grooves were checked and found satisfactory before the belts were installed, so possibility of differential driving can be ruled out. An inspection of the apparently long belt is made. Chances are that it was pried over the sheave in installing, and a spot where the belt has narrowed, or "necked down" will be found. This is the point at which the tensile section was damaged on installation.

It may be found that frequent take-ups are necessary and drive service is consistently lower than it should be. This would suggest that the drive is overloaded. The engineer should check the design to see if this is actually a case of overloading. If so, it would pay to use premium-rated belts at the next replacement.

There are occasional situations over which the operator has no control. If the drive consistently runs out of take-up before the belts have failed, it may mean that not enough provisions for take-up have been made. This, and similar problems, should be referred to the design engineer for review.

—The End

About the Author

W. S. WORLEY is chief engineer of the Product Application division of The Gates Rubber Company. He attended Western State College at Gunnison, Colo., and the University of Colorado, where he majored in mathematics and physics. He joined The Gates Rubber Company in 1942 after spending six years in sales work.

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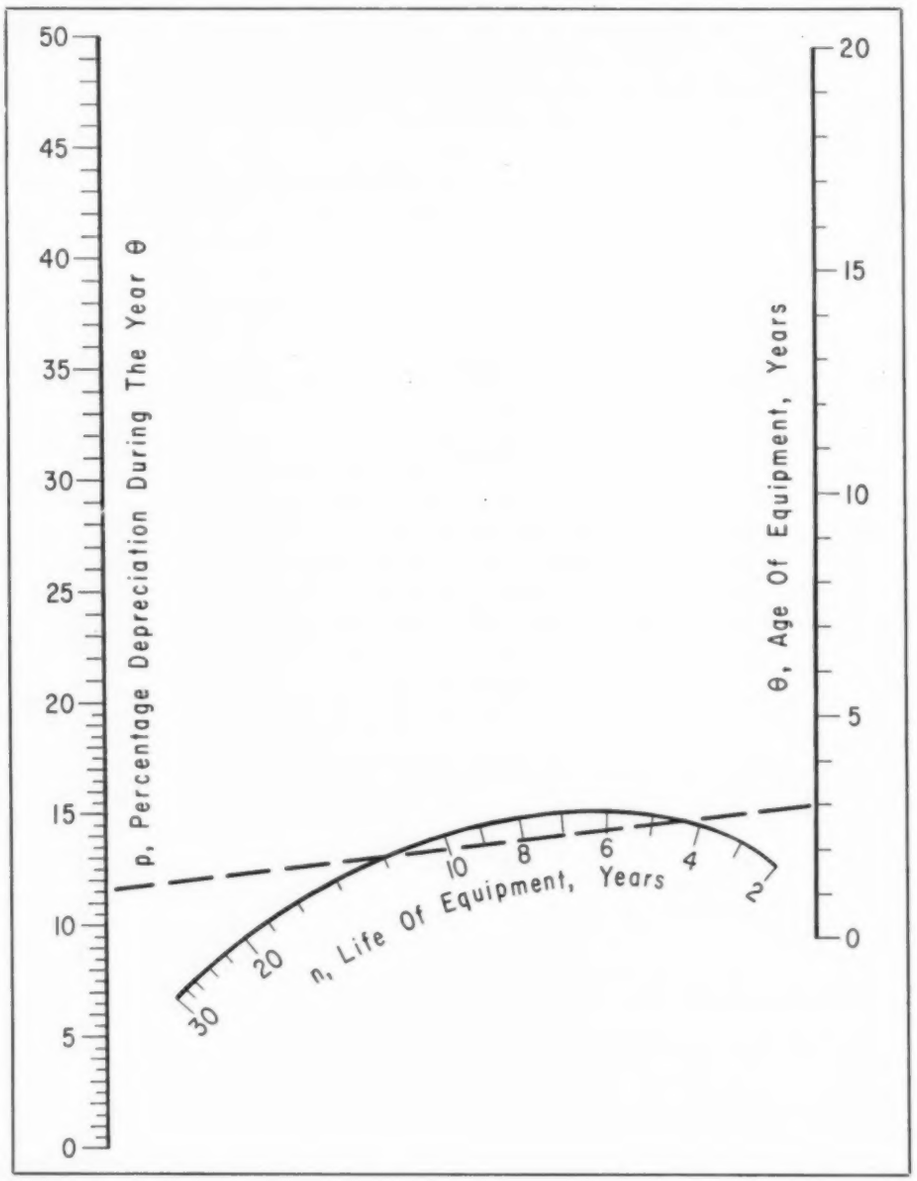


Miscellaneous

—33—Depreciation by Nomograph

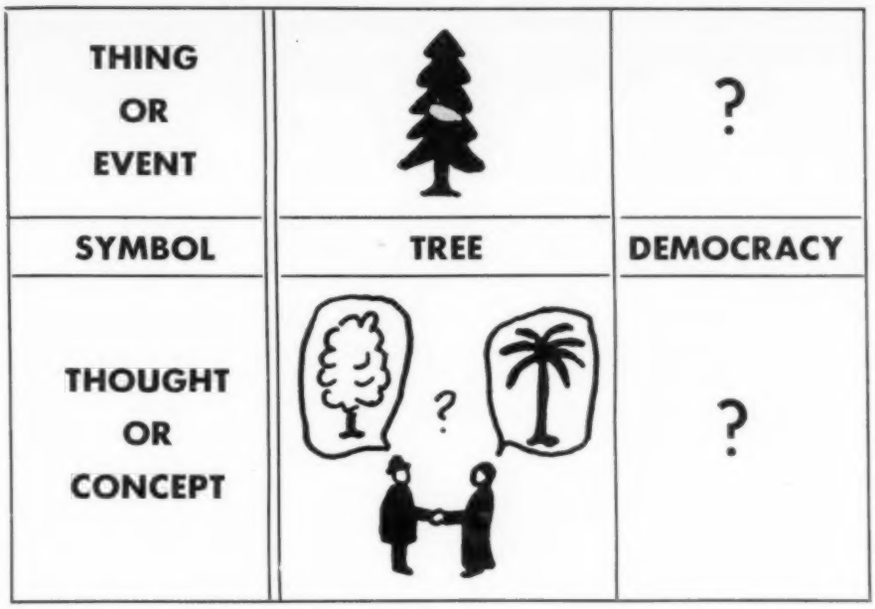
Using the sum-of-digits method where applicable, the percentage depreciation to be charged to a piece of equipment at the first of any given year, can be figured as,

$$P = 200\ \frac{(n - \Theta)}{n(1 + n)}$$

where

P = Percentage depreciation for the year.
n = Total estimated years of life
Θ = Age in years

From the chart above—what percentage allowance should be made for the third year of a piece of equipment that has an estimated life of 12 years? Connect 3 on the Θ scale and 12 on the n-scale, giving you the desired "P" of 11.5 percent.



A graphic portrayal of the problem of language in bridging the gap between things and thoughts. It is difficult enough to achieve this rapport with respect to simple physical objects, let alone abstract ideas such as democracy, justice and so forth.

Cartoon reproduced by permission from ETC., A Review of General Semantics, Vol. III, 201 (Spring, 1951).

How to Say What You Mean

Are your employe communications successful . . . or are they failing to bridge the gap? These six factors can give you the answer.

By ANATOL RAPOPORT
Mental Health Institute
University of Michigan, Ann Arbor

WHAT YOU MEAN is inside you. It is a mixture of memories, mental pictures, desires, ideas about what is so and what isn't, about what should be and what shouldn't.

What you say is a disturbance in the air about you, which you have started by moving your lips, tongue and vocal cords. It should seem preposterous to expect an exact correspondence between the two sets of events. Yet we do expect it, else what do we mean when we expect to say what we mean? We take communication for granted, just as we take the smooth functioning of our bodies for granted. We become aware of either only if something goes wrong.

Something does go wrong often enough in communication. Difficulties of communication fall into two general categories:

1. The communicants *A* and *B* do not use the same symbols (words, expressions) to describe similar experiences; or

2. *A* and *B* do not share similar experiences.

The first situation is relatively easy to deal with; the second much more difficult. The simplest example of the first situation is a language difference. Both *A* and *B* eat, and eating is a similar experience for both. But *A*, speaking English, says, "eat," and *B*, speaking French, says, "manger." It is not hard for *A* and *B* to recognize that "eat" and "manger" mean "the same thing," and communication can be easily established by translation.

Even though the Tower of Babel had to remain unfinished because of the "confusion of tongues," ordinary linguistic differences are not a major obstacle to human communication. With a little training and a dictionary a German physicist can read a Russian physics journal, because the experiences of Russian and German physicists in their professional field are similar.

It is quite another story when *A* and *B* do not share a similar experience. No matter how carefully we define the "meaning" of blue, we cannot impart that meaning to a blind man. Attempts at careful definitions often confuse the issue still further, because an agreement on a formal definition often gives a false impression that the meaning of a word has been agreed upon. But the meanings are not in the words or in their definitions (which, after all, are only other words).

Meanings are in people, in the internalized experiences behind the words. If the experiences are not shared, neither are the meanings, and it seems to both parties that the other is distorting the meanings of words. When accusations of distortion are

made, each of the would-be communicants becomes even less receptive to the experiences behind the meanings of the other, and the chances of establishing communication are worse.

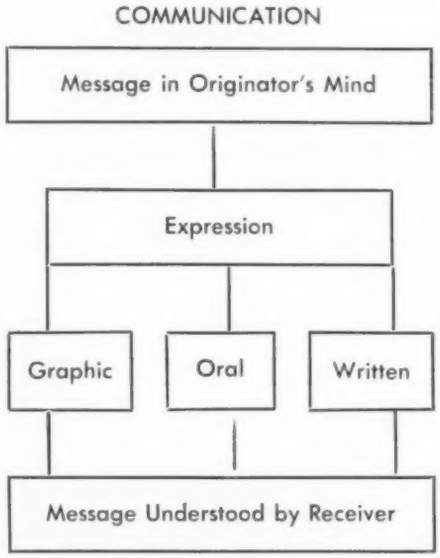
Most Americans, for example, are convinced that the correct meaning of the word "democracy" is implied in the nature of American institutions such as the two-party system, private enterprise, and the custom of villifying umpires at baseball games. When the Russian uses the same word to apply to the one-party system, government enterprise, support of independence movements in Asia and Africa and the crushing of similar movements in Eastern Europe, Americans feel that the Russian corrupts the true meaning of democracy, either through ignorance or by design. We feel that democracy is democracy and dictatorship is dictatorship, and that the Russians are befuddling the issues by not calling things by their right names.

The first principle that becomes apparent to any student of language as a form of human behavior is that there are no right names prescribed by the natural order of things. The relation between names and experience is an arbitrary one, imposed by the people who have experiences and use names to denote them.

The important thing in communication is for the communicants to use the same names for approximately the same experiences (no two experiences are exactly alike). The agreement on what names to use is a small matter. If it makes you understand me better, I am willing to call dogs cats and cats dogs. The difficulty is in acquiring and sharing similar experiences.

The entire communication problem revolves around the experiences of the communicants. The problem of saying what you mean has no other meaning. You can be as precise as you like in your choice of words, follow the most august authorities and consult the most unabridged dictionaries. You can make your speech formal or chatty, erudite or folksy, polysyllabic or monosyllabic, bristling with technical terms or on the level of the *Reader's Digest*. Your success in communicating depends on none of these gimmicks unless you have succeeded somehow in tapping the range of experience of your communicant.

It is useless to "say what you mean," unless by doing so you can impart your meaning to your communicant. Sometimes this happens of its own accord, because the other needs your experience. In that case, he will do the whole work of reaching you, of ferreting your meaning from you. But this is not where communication difficulties are typical. Communication difficulties arise when all you want to do is impart your meaning to the other, and all he wants to do is to impart his meaning to you. Both want to "communicate to." Neither wants to "be communicated to."



A graphic definition of communication. Effectiveness of communication may be increased by the coordination of graphic, oral and written expression.

It is possible to break this deadlock, simply by giving in, by becoming an active listener. If this change of role is reciprocated (most acts between human beings are reciprocated, both good and bad), communication becomes less of a "talking to" and more of a "talking with." By and large, it is safe to say that people who feel most inadequate in imparting their meaning to others are precisely those who never try to get others' meanings imparted to them.

No less important than the ability to listen (that is, to reproduce in one's self the other's experience) is the ability to gear one's own communication to the experiences of the other. This staying within the range of the other's understanding or interest requires constant checking, partly maintained by listening interspersed with talking (what is now called "feedback" in communication science), partly by a constant examination of one's own communication process.

There are certain questions you can ask yourself while trying to communicate, which in the answering may help you get greater insight into the communication problem:

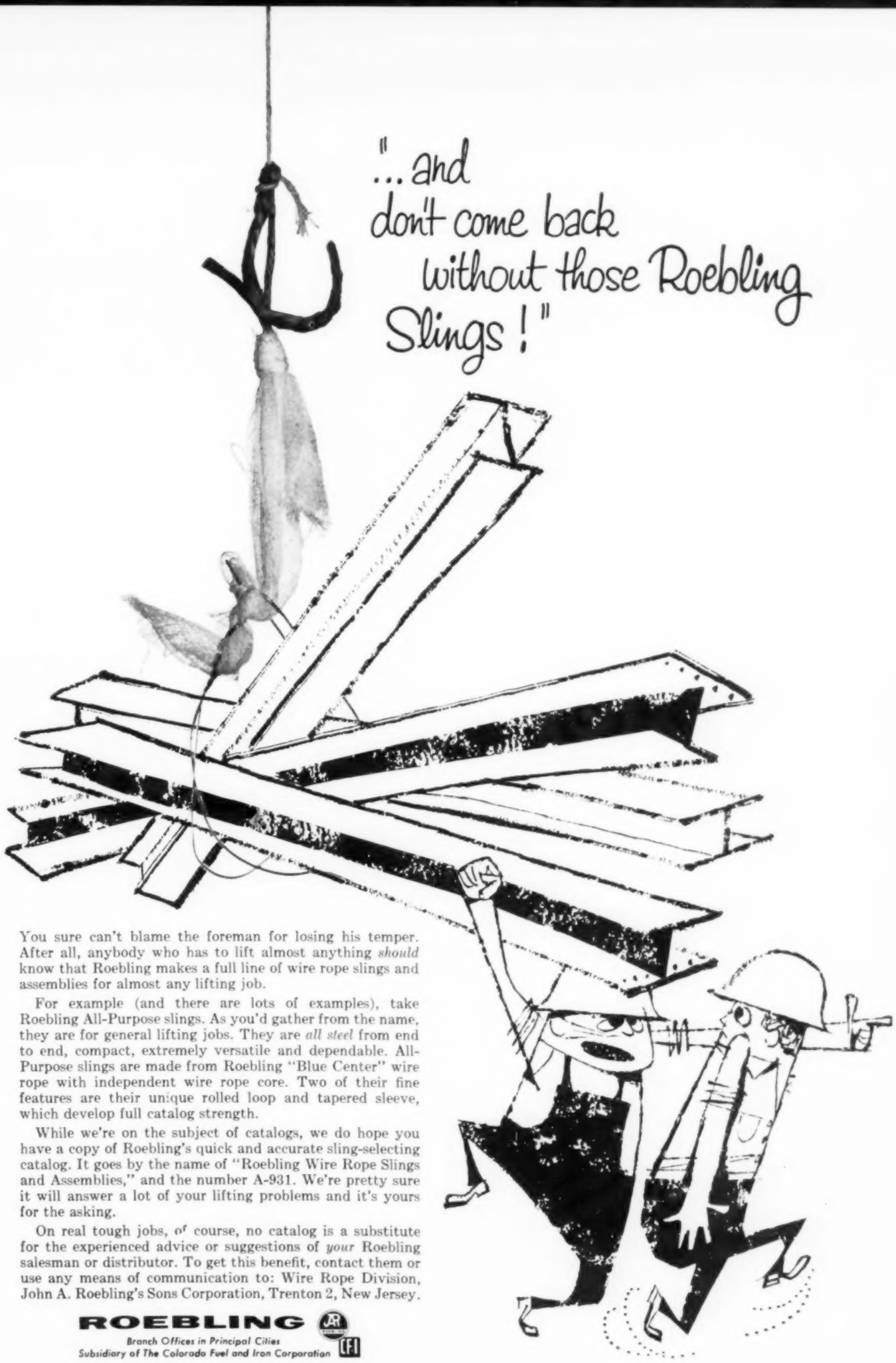
What is the Purpose of Your Communication? A vast amount of communication has one purpose only —to manipulate behavior toward specific, pre-conceived ends. The explicit and implied exhortations of consumer advertising, of publicity and of political campaigns are examples. The ultimate purpose of these communications is always the same: to get the "targets" to perform some simple act, for example to buy a product or to vote for a candidate.

The question "How can we say what we mean?" hardly applies to this type of communication, because all too often the real meaning of such messages is anything but acceptable to the "targets." Interest in the receiver of such communication is limited strictly to his potentiality as a customer, voter, loyal employe, etc., so that the "success" of this type of communication depends rather on how well this meaning (attitude) is disguised (by appeals to the target's supposed interests) than revealed.

It is worthwhile to say what one really means only in genuinely informative communication, that is, communication whose purpose is to share actual experience. This experience may include views and convictions as well as information, and the purpose of the communication may be to convince and convert as well as to inform. However, it is the sharing of the experience, not the manipulation of gross behavior which is central.

If then, the purpose of a communication is truly informative (including the sharing of attitudes, views and convictions), the crucial step is to find areas of experience already shared and to try to enlarge them so as to include the experience to be communicated.

What is the Level of Your Communication? Several such levels are recognized. There is a level of pure



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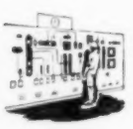
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reporting, descriptions of facts, things, or events, which can be directly verified.

There is a level of *inference*, statements which are not results of direct observation but which are deduced from observations.

There is a level of *judgment*, statements containing implications of right and wrong.

There is a level of *directive* statements suggesting, asking or demanding action.

The question, "What is the level of the communication?" serves to make us aware of what we are actually trying to communicate, a piece of information, an opinion, an attitude, a request or a command. It should be easy enough to distinguish between these "modes," but often the level of the communication is obscured by the words in which it is couched. Since the level is part of the meaning, it is important to keep the communicant informed of the level at which the communication is meant.

Are the Verifiable Facts or Descriptions You Are Reporting Accessible to the Communicant? Must he take your word for them, can he check them directly or in some other way? Any of these supporting suggestions is permissible in proper circumstances, but it is a good idea to make clear on what basis the communicant is to believe your factual story.

Do You Label Your Inferences and Indicate Your Reasons for Making Them? If you take for granted that any one in his right mind would make the same inferences you make, those who do not wish to make the same inferences will tend to blame not their own logic but yours. If you disguise your inferences as facts, those who disagree will think you are ignoring the truth.

To guard against the breakdown of communications at this point, it is a good idea to make clear where the factual story ends and where the inferences begin together with the reasons which have led to your inferences. In this way, the communicant is not intimidated to make the same inferences but merely invited to examine your point of view. Still better is to present clearly and fairly an

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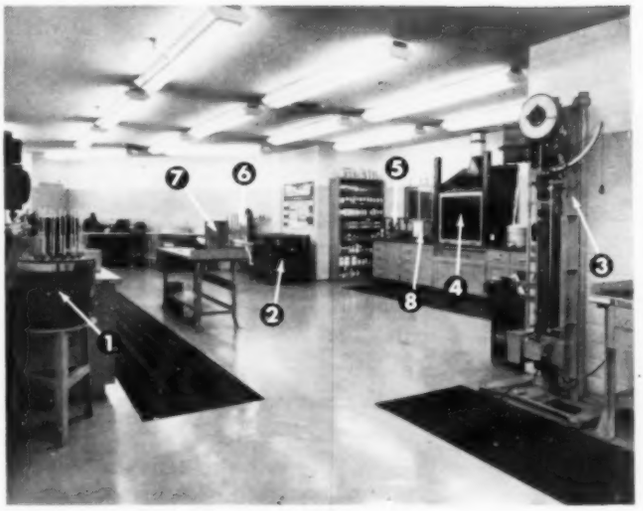

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alternative course of reasoning leading to other inferences (say, an opponent's) together with your reasons for preferring your own.

Do You Label Your Judgments? A judgment is based on a set of values. If you simply take your own set for granted or endow it with superior moral worth, you are in effect telling your communicant (who may operate under a different set of values) that unless he accepts your values, he is morally inferior. Since attitudes tend to be reciprocated, the communicant will usually feel that it is you, not he, who is morally inferior.

There is not much incentive to share experiences with morally inferior people. That is not to say that moral considerations should be excluded from communication. All of us have moral convictions and feel strong pressures to communicate these convictions to others. If, however, you wish to be sure that the channels of communication remain open (and nothing is so deadly to communication as an argument about what is moral), you must make clear that your judgments are based on a particular, clearly labeled set of values. You must make these explicit and present them as yours, not as something universal and undeniable.

Awareness of alternative convictions and the recognition of their legitimacy, as, for example, when they are derived from another set of experiences, will stimulate such awareness in others, and your convictions will become less preposterous to those who do not share them. Meaning is less likely to be obscured by moral indignation in you or in your communicant.

Do You Bolster Your Directives by Reasons Which Make Sense to Those Who are to Carry Out the Directives? If your communication is to achieve not simply compliance (which is all that despots and children having tantrums are interested in), but a compliance based on understanding, you must dispel any possible notion that your directives are nothing but a show of authority or caprice. To do this it is necessary to show that compliance is of some benefit to you or to your communicant or to some larger unit. You must, of

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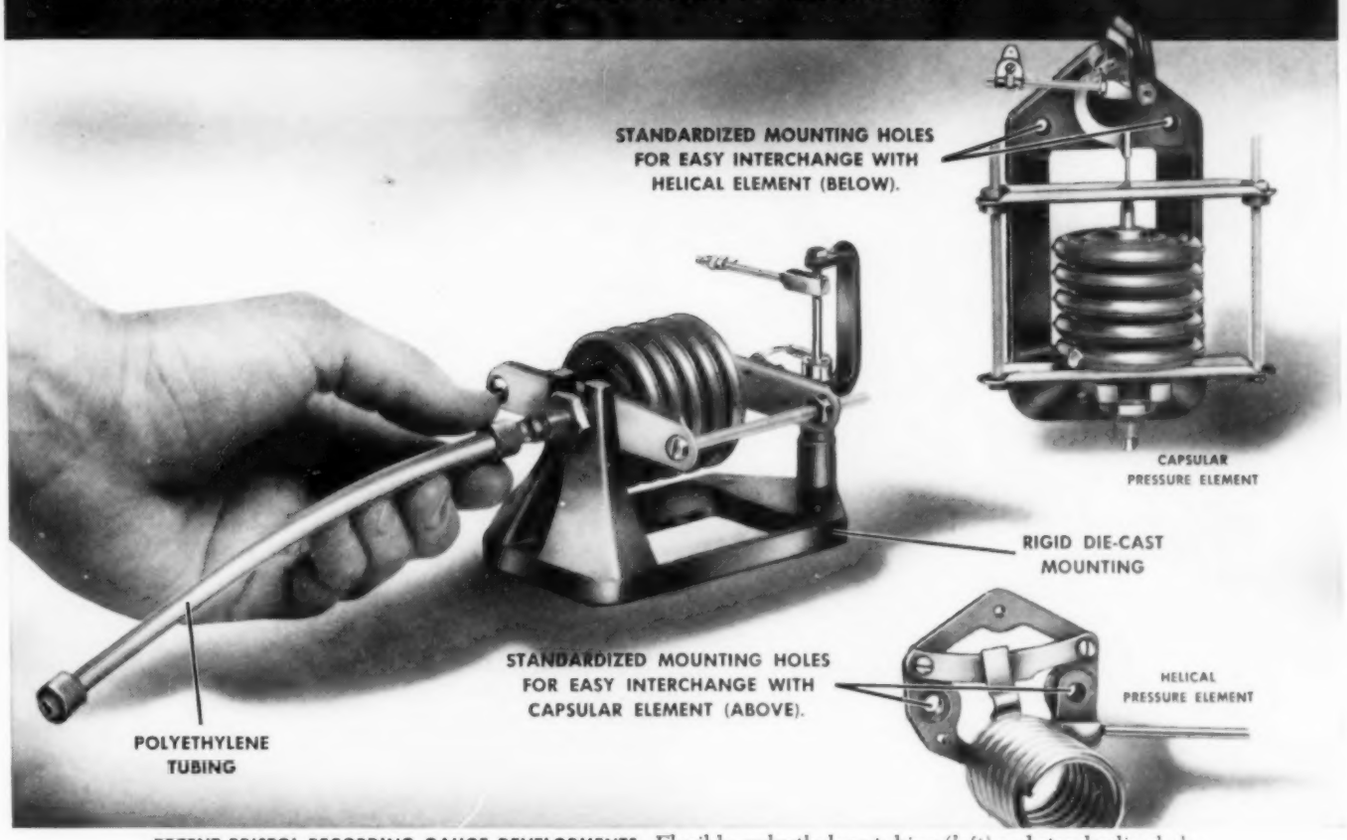
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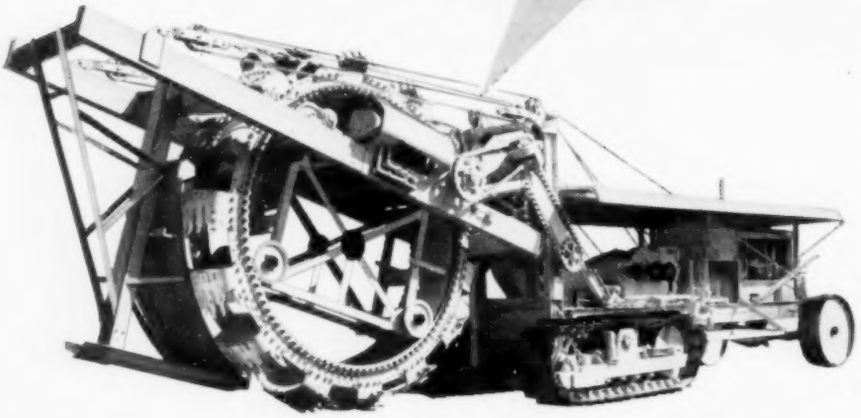

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course, show why this is so and in the process leave no doubt about what is fact, what inference, and what judgment.

If what you are asking benefits primarily you, you must say so. You have a right to ask favors or services from others (who have similar claims on you). There is no need to disguise these requests to make it appear that you have only the communicant's welfare in mind. Such stratagems are easily found out and destroy confidence.

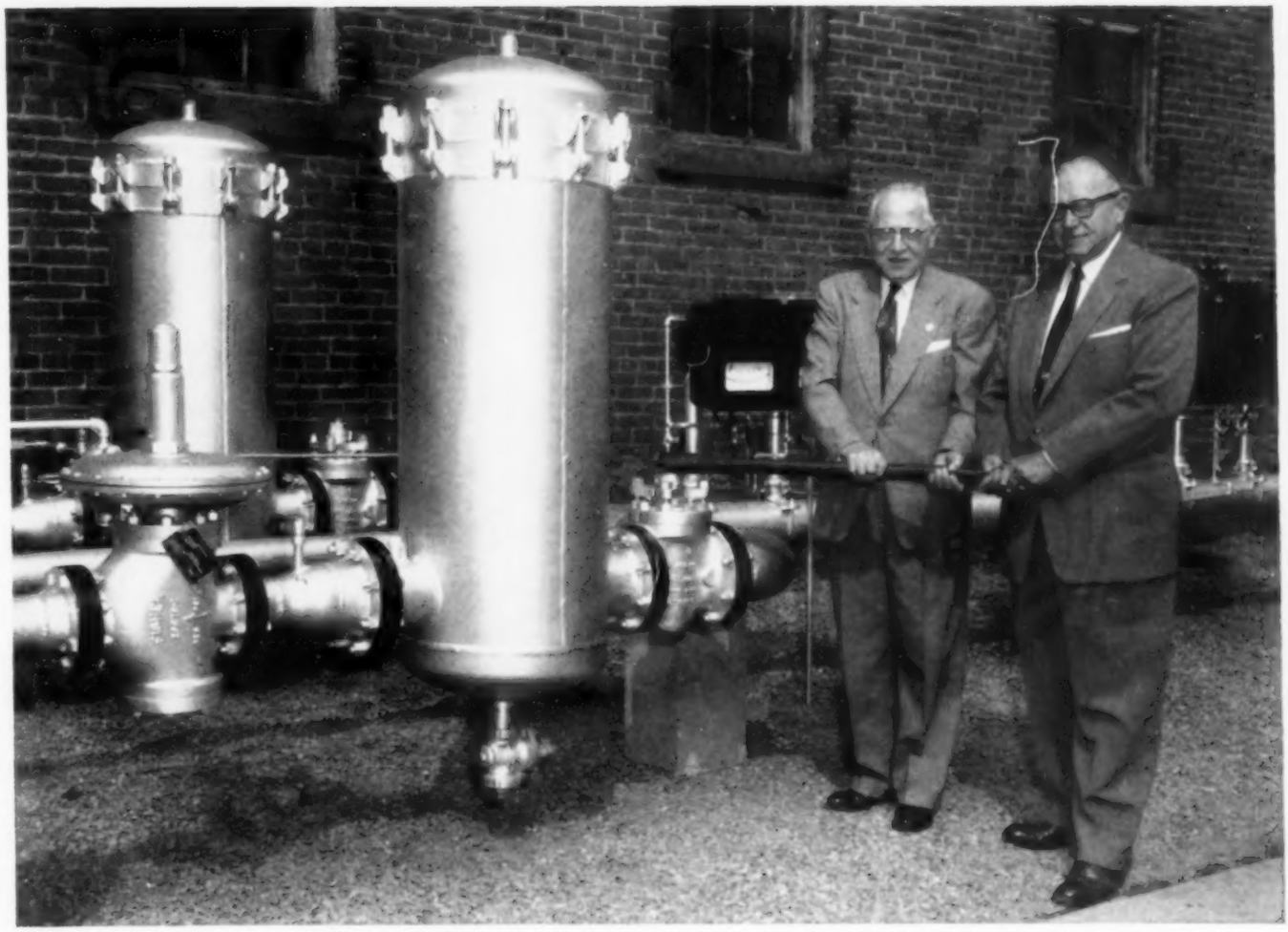
In short, there is one paramount principle of sound communication (called by some people *language hygiene*). Communication is sound if it is a two-way process. It is a two-way process if the communicants stick to their area of common experience and keep enlarging it.

It is the responsibility of each communicant to enlarge the area of his own experience, so that more of it is shared with the other. There is only one way to enlarge one's own area of experience: this is to be somebody else for a while.

You cannot, of course, assume the other's identity, but you can get some idea how it feels to be the other by developing techniques of attentive and sympathetic listening. When you are faced with linguistic differences, this point is so obvious that it hardly needs to be stated. No one has ever learned a foreign language without having his ear accustomed to a set of different (foreign, strange) sounds. No one has ever internalized another language without getting rid of a conviction that there is no right way to speak, that various people have developed various ways of speaking, each pretty nearly as serviceable as the rest.

Much has to be learned yet about the differences of meanings which people attach to the same words and expressions because of different backgrounds of experience. In a way, then, learning to communicate is constantly learning a somewhat different language, one for each person one meets.

Only when you have learned to command the language of the other can you hope to be able to "say what you mean," that is, to impart your real inner meaning via an air disturbance or a collection of ink marks, into the sanctum sanctorum of the other's inner self. —The End



Charles H. Gueffroy, left, president of Portland Gas & Coke Co., and Carl E. Braun, vice-president and manager of Publishers Paper Co., Oregon City, Ore., "turn on the gas" at latter's plant. In foreground are two 6-inch Staynew filters, Model CPHG-10030, part of a large purchase by Portland utility.

Portland Selects Staynew Filters

for Natural Gas Piped from New Mexico

A spectacular 1,500-mile pipeline, bringing natural gas from New Mexico to Portland, Ore., promises a great new source of thermal energy to industries looking for locations, as well as savings of hundreds of thousands of dollars yearly to home gas users.

Portland Gas & Coke Co., which has been in business nearly 100 years, made a rewarding installation of Staynew filters in 1954, and, as a consequence, selected Staynew to filter much of its new supply of natural gas. Staynew filters purchased by the Portland utility in 1956 alone, it is conservatively estimated, are now filtering 25,000,000 scfd. It is also believed that more than 2,000,000 scfd are being filtered into homes by the new Staynew Model CPHB home gas filter.

Whatever *your* filtering problem, there is a Dollinger representative nearby, ready to help you solve it. Write Dept. 68, Dollinger Corporation, 95 Centre Pk., Rochester 3, N.Y.

REG PROTECTOMOTOR U.S. PAT. OFF.

STAYNEW **DOLLINGER**

FILTERS

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

For more data on advertised products, use Readers' Service Cards, last page.

WHAT'S HAPPENING

IN PIPE LINE CONSTRUCTION

Ruhr Area-North Sea Pipe Line Contract Let

A contract has been awarded to Ruhrgas A. G., Essen to construct the 224-mile, 28-inch crude line linking Köln (Cologne) in the West Germany Ruhr area with Wilhelmshaven on the North Sea.

Nord-West Oelleitungs G.m.b.H., builders of the line, was formed last November and is comprised of six of West Germany's leading oil firms. The six will share the $48 million cost. Esso A. G., Hamburg, which is supplying 60 percent of the capital, will be the line's largest user.

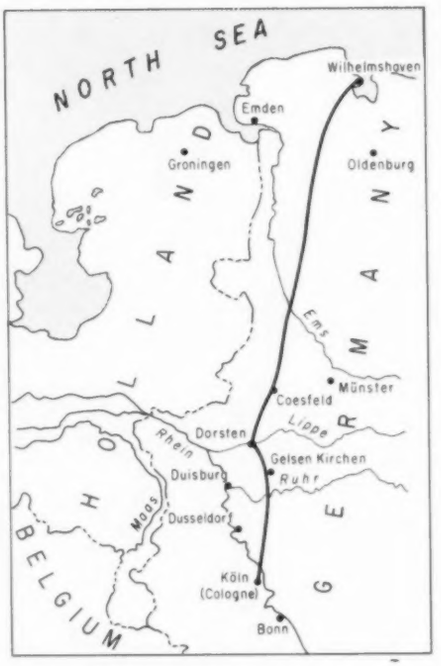
Construction of the pipe line, harbor installations and storage tanks is scheduled to begin late this year. The line's initial capacity has been set at 120,000 to 160,000 barrels per day. An increase to 400,000 to 460,000 is planned later.

Tanker wharves will be constructed ¼ mile into the Jade, Wilhelmshaven's channel to the North Sea. Initial facilities will handle two tankers simultaneously with later plans for handling four.

Twelve million of the total $48 million pipe line cost will be spent in Wilhelmshaven. A pumping station with an annual capacity volume of 9.6 million tons of crude will be erected in the Heppener Groden area which is near the tanker discharge viaduct. Storage facilities are also planned here.

Additional pumping stations will be erected along the pipe line as the volume grows. Company officials hope to reach a maximum of 20 million tons annually by 1965.

Construction of the pipe line alone will take six months. A 200-man crew will lay the line at the rate of 1½ miles a day. Whether construction begins in Wilhelmshaven or Cologne will depend on scheduling of pipe deliveries.



Route of proposed Cologne-Wilhelmshaven line.

Deutsche-Shell Announces Crude Line Expansion

Deutsche-Shell A. G. has included a 120-mile pipe line in their recently announced $170 million expansion program in Germany. The crude line would link Deutsche-Shell's proposed new refinery between Cologne and Bonn with the Rotterdam terminus of the immense Sappeur pipe line project across Europe which calls for a major large-diameter crude pipe line from Marseilles to Rotterdam.

Expected completion of both the refinery and pipe line is 1960. The cost of the pipe line, 20 and 24-inch in diameter, is estimated at $28 to $34 million. The daily capacity in initial stages has been set at from 160,000 to 200,000 barrels daily.

Gelsenberg Benzin A. G., operator of a 60,000 barrels daily refinery at Gelsenkirchen, is a partner with the Shell company in constructing the pipe line.

Recent reports from Germany have speculated that Union Rheinische Braunkohlen Kraftstoff A. G. may also participate in the project. The Union Rheinische company operates a 28,000 barrels per day refinery at Wesseling which is just a few miles from the proposed Shell refinery site.

Petex Will Conduct October Gas School

The University of Texas Petroleum Extension Service will conduct a six-week School of Gas Technology in Houston next fall. Course material will cover natural gas production, gathering, regulation, purification and transmission. Instruction will begin on October 14 and will include lectures by outstanding industrial and college specialists, exhibits, demonstrations, discussions, motion pictures and field trips.

Israel Line at Gulf of Aqaba

Pictured above is a portion of the crude line from Eilath to Beersheba. Work is now underway on an extension of this line.

Texas Illinois Gets Okay For Two Gas Projects

Thirty-eight miles of pipe line parallel to the present Volo lateral line north of Joliet and ten miles parallel to the main line southwest of the city will be constructed by Texas Illinois Natural Gas Pipeline Company late this fall.

A 36-inch diameter pipe line along the Volo line from the company's Joliet regulator station to a point 1½ miles north of the Du Page County line near its Howard Street meter station will replace a 20-inch line which has been in service in the area since 1951.

The 10-mile segment of 36-inch line parallel to the main line will extend from the Illinois River to the regulator station.

The Federal Power Commission has granted permission for both segments of the project, and work will begin as soon as shipments of pipe are received. Pipe delivery is expected in late fall with present plans calling for a spring, 1958 completion date.

Construction Under Way On Alberta Crude Line

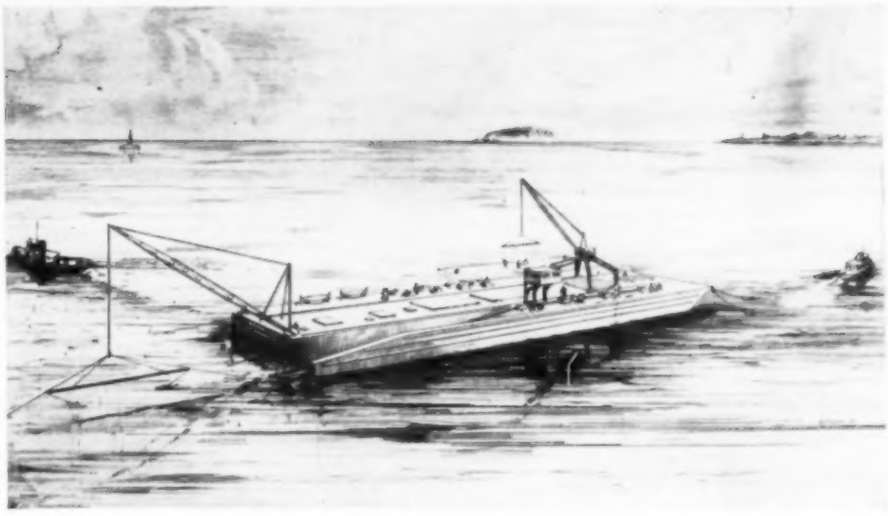
Gibson Crude Oil Purchasing Co. Ltd. of Calgary has awarded a contract to Hutchison Construction Ltd. of Leduc, Alta., for construction of a new crude oil pipe line.

The line will be laid from the Bellshill Lake oil field in Northeastern Alberta to tie in with Interprovincial Pipe Line's pump station near Hardisty.

The main line will consist of approximately 19.4 miles of 6-inch pipe while the gathering system includes approximately three miles of lateral lines. The line will have a capacity of 15,000 barrels per day and the initial throughput is expected to be near 2500 barrels per day.

Gibson will install two 20,000 barrel welded storage tanks adjacent to the Interprovincial pump station and will also provide the necessary facilities for injection of the oil into the suction side of Interprovincial's pumps.

The line is expected to be in service before the end of June.



Artist's sketch of Brown & Root's $2.3 million pipelaying barge.

Brown & Root Lets Contract For Huge Pipelaying Barge

The contract has been let for construction of a $2.3 million deep-sea pipelaying barge for offshore oil field work. The new Brown & Root vessel will measure 350 feet long, 60 feet wide and 22.6 feet deep.

Expected delivery is December 1. Levingston Ship Building Corp. at Orange, Texas, is constructing the ship designed by Brown & Root's marine engineers.

The barge will feature unusual versatility. Equipped to lay both concrete-coated pipe or pipe coated with special processes, the barge can also be used for pile driving, setting offshore structures, laying marine cables and other miscellaneous offshore work.

The vessel will have an 80-ton traveling gantry crane with a 120-foot boom. A central control tower will handle the winches and move the barge through the use of its 10,000 pound anchors. Flood lights will allow night operation.

Air-conditioned quarters for 88 men with separate quarters for X-ray crews and customers' personnel are included in the floating hotel. Storage facilities on board will carry up to six days supply of pipe.

NATO Oil Supply Projects Open to International Bidding

Bidding was opened recently on construction projects in France, West Germany and Belgium as the North Atlantic Treaty Organization continued its efforts to develop an oil supply network.

Five projects in France, estimated at a total of over $8.3 million, were opened to the international competitive bidding.

The projects include the supply and construction of a petroleum products depot at Phalsbourg, estimated cost $1.8 million; construction of 11 pumping stations in northwest and northeast regions, $4 million; installation of pipe lines connecting with the Havre complex, $1.1 million; installation of pipe lines at Chalons junction, $511,000; and supply of pipe for connecting junctions at Chalons, Langres and Mirecourt, $860,000.

The three German projects are located in North Westphalia. The Commerce department announcement gave no estimated costs on these.

The three projects include the construction of semi-submerged petroleum products containers with steel insert; installation of 2.5 miles of dual eight-inch petroleum products pipe lines, with river crossings; and the furnishing and installation of 28 miles of eight-inch petroleum products pipe line.

The Belgian project is located in Hainaut Province and calls for the construction of a petroleum depot. The estimated cost is $480,000.

Canadian Government Awards Contracts on Trans-Canada Line

Four contracts totaling $15.6 million have been let for construction of 310 miles of a 675-mile section of the Trans-Canada natural gas pipe line.

Northern Ontario Pipeline Crown Corporation, formed by the federal and Ontario governments, awarded the contracts for the 30-inch line covering the section from the Ontario-Manitoba border to the Port Arthur, Ont.-Ft. Williams area. On completion the section will be leased to Trans-Canada Pipe Line Ltd. with an option to purchase.

Contractors on the four spreads are Dutton-Williams Brothers Ltd., 58 miles; Morrison-Shivers Ltd., 94 miles; Majestic Contractors and Associates, 80 miles, and Houston Contracting Company, 78 miles. Estimated cost of the entire Northern Ontario section is $120 million. The new contracts cover Northern Ontario's program for this year.

The Northern Ontario program is part of the over-all Trans-Canada 2294-mile line from Alberta to eastern Canada. Trans-Canada will complete the 586-mile western section started in 1956 and will construct 85 miles of 30-inch from Winnipeg to the Manitoba-Ontario border in 1957. Also included in Trans-Canada's 1957 plans are 310 miles of 20-inch line from Toronto to Montreal and 33 miles of 24-inch line to connect with the terminus of the Niagara-Toronto line.

By the end of 1957 approximately 60 percent of the total line is expected to be completed.

165-Mile Muskegon Line Completion Set for '57

The newly organized Muskegon Pipe Line Corporation expects to complete by late this year a crude oil pipe line to supply refineries at Muskegon. The 165-mile, 10-inch line will run from Griffith, Ind., to Muskegon, Mich.

When completed, the line will supply the Aurora Gasoline and Naph-Sol Refining companies and will have an initial capacity of about 26,000 barrels per day.

The general route of the line follows the Lake Michigan eastern shore, but will be several miles inland.

The Muskegon Corporation is a joint undertaking of Aurora and Service Pipe Line Company of Tulsa. Wm. E. Slaughter, Jr., Aurora's president, heads the new pipe line company. Other officers include, M. S. Schiller and Harris Squire, vice presidents; J. R. Fredenberger, secretary-treasurer and C. W. Butler, director.

17 Firms Shape Plans For Mid-East Crude Line

Seventeen oil companies have joined together to proceed with plans for an $840 million crude oil pipe line system from the Middle East to the Mediterranean.

At a recent meeting in London, nine U. S. companies joined the original eight companies who met in March to make plans for the new line, which will move Middle East crude to a point on the Mediterranean, bypassing the Suez Canal. Plans call for an 800,000 barrels per day line, later expanding the system to 1.4 million b/d capacity.

Route of the proposed dual 38-40 inch pipe line is not definitely decided, but it has been reported that the line will extend from the head of the Persian Gulf through Iraq and Turkey to the Turkish coast of the Mediterranean.

Companies participating in the conference at which a continuing committee was appointed to map solutions to problems facing the proposal include American Independent Oil Company, Atlantic Refining Company, Compagnie Francaise des Petroles, Getty Oil Corporation, Gulf Oil Corporation, Hancock Oil Company, Richfield Oil Corporation, San Jacinto Petroleum Corporation, Signal Oil and Gas Company, Socony Mobil Oil Corporation, Standard Oil Co. of California, Standard Oil Company of New Jersey, Standard Oil Company of Ohio, The Texas Company, Tidewater Oil Company, Royal Dutch-Shell and the British Petroleum Company, Ltd.

FPC Gives Temporary OK For Ohio Fuel Gas Project

Ohio Fuel Gas Company has received temporary authorization from the Federal Power Commission to construct natural gas facilities in Ohio.

The temporary authority covers 37.7 miles of 24-inch loop lines from Crawford station, Fairfield County, to Treat station in Licking County, and a tie-in for the 24-inch line at the Crawford station.

Three Ohio Fuel projects estimated to cost $4.7 million are included in one FPC application. The projects, in addition to the 37.7 mile loop line, include 17.2 miles of 20-inch in Jackson and Gallia counties, and installation of two 1500 horsepower units at Crawford compressor station.

Colorado Interstate Line Gets Temporary Approval

Temporary authorization has been granted by the Federal Power Commission to Colorado Interstate Gas Company to construct and operate 50 miles of 22-inch line to receive new gas supplies from the Mocane field area of Oklahoma.

Estimated to cost $2.4 million, the line will extend from the Mocane field area to a connection with the company's existing system at Hooker, Okla. The line is a part of a larger project proposed by Colorado Interstate in an application pending before the FPC involving increased delivery by Colorado Interstate to Natural Gas Pipeline Co. of America at Beatrice, Neb.

Planned Buckeye Line Will Carry Products

A 70-mile products pipe line is planned by the Buckeye Pipe Line Company of New York. The 8-inch line will run from Wayne to the vicinity of Durand, Mich. This will provide refiners in the Detroit and Toledo areas with a common carrier products line into central Michigan.

The line will also make available to shippers transportation to the cities of Lansing, Saginaw, Flint and Owosso.

The $2 million line should be completed early in 1958.

REPORT on new shovel-crane standards:
(one in a series)

BONUS FEATURES available as optional equipment on most Link-Belt Speeder models include Independent-Swing and Travel which eliminates shifting, saves 20-30 seconds each move . . . long, wide crawler base . . . torque converter . . . and reversing clutches for either or both main drums. Speed-o-Matic, the fingertip-operated, fatigue-cutting, true power hydraulic control system is standard on all models.

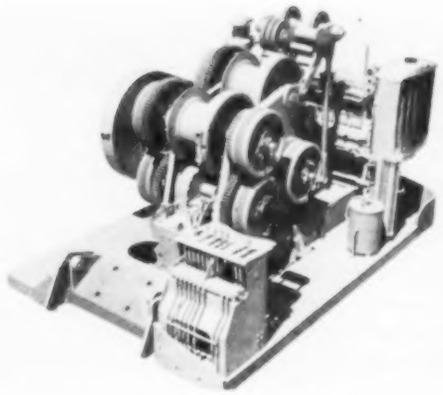
Gaining a BIG power bonus

Size for size, Link-Belt Speeder trench-hoes deliver greater usable horsepower than other machines using the same engines

Why? Because a Link-Belt Speeder is engineered for extra-structural strength to take full advantage of the engine's available horsepower and still remain well within engine manufacturers' recommended speeds. For example, Model X when run at 1200 rpm develops *75 hp* . . . at 1600 rpm it develops *100 hp!*

Thus, with a Link-Belt Speeder on your job you've got more usable power—extra power to sock the dipper into the cut, come up with a full load. And you've more power to hoist, swing and travel.

And bonus horsepower is but one of many reasons why Link-Belt Speeder owners have been able to completely revise and upgrade their standards of shovel-crane performance. Why not see your Link-Belt Speeder distributor for the complete story or write Link-Belt Speeder Corporation, Cedar Rapids, Iowa.



Size and strength of components

In a Link-Belt Speeder you'll find big, extra-strength shafts, clutches, gears and other components . . . units easily able to handle the extra power the machine's engine develops. Result—more production and yet lower cost of maintenance and service . . . less downtime, more work time. 14.549

It's time to compare . . . with

LINK-BELT SPEEDER

Builders of a complete line of shovel-cranes . . . with exclusive Speed-o-Matic power hydraulic controls

Recent aerial photograph of Standard Pipeprotection plant, showing increased facilities.

Each successive year more pipe passes through the St. Louis Gateway, where at Standard Pipeprotection it is coated and wrapped according to procedures that establish the highest standards of quality for pipe protection.

This increased traffic has necessitated the erection of extra pipe storage areas with greater capacity, additional railway sidings, new coating and wrapping machines, much larger parking areas, more roads for truck deliveries and enlarged office space.

The benefits you receive from SPI coated and wrapped pipe have resulted in more business for us.

standard pipeprotection inc.
3000 SOUTH BRENTWOOD BLVD. • ST. LOUIS 17, MISSOURI

Sumatra Line to Deliver Duri Field Crude to Port

Construction has begun on a 30-mile, 30-inch crude pipe line between the Duri field in Central Sumatra, located about 40 miles northwest of the Minas field, and the port of Dumai, located opposite Rupat Island on the Malacca Strait.

The line being built by International Bechtel, Inc. of San Francisco, Calif., is part of a larger project planned by the Caltex Pacific Oil Company to link both the Duri and Bekasap oil fields to a proposed deep-water tanker terminal on the northeast coast at Dumai on the Strait.

Scheduled for completion in late 1958 or early 1959, the 30-mile Duri-Dumai line runs through difficult swamp country.

A spur of about 14-inch diameter, to connect the Bekasap with the Duri field less than ten miles away, is definitely planned. Because it is unlikely that production from Duri and nearby Bekasap oil fields will utilize the full capacity of the system, a second spur is being considered. In order to make full use of the line, eventual expectations are for a large-diameter crude line to be built along the roads from the prolific Minas field to connect with the Duri-Bekasap-Dumai system. The Minas-Duri line would be approximately 40 miles long.

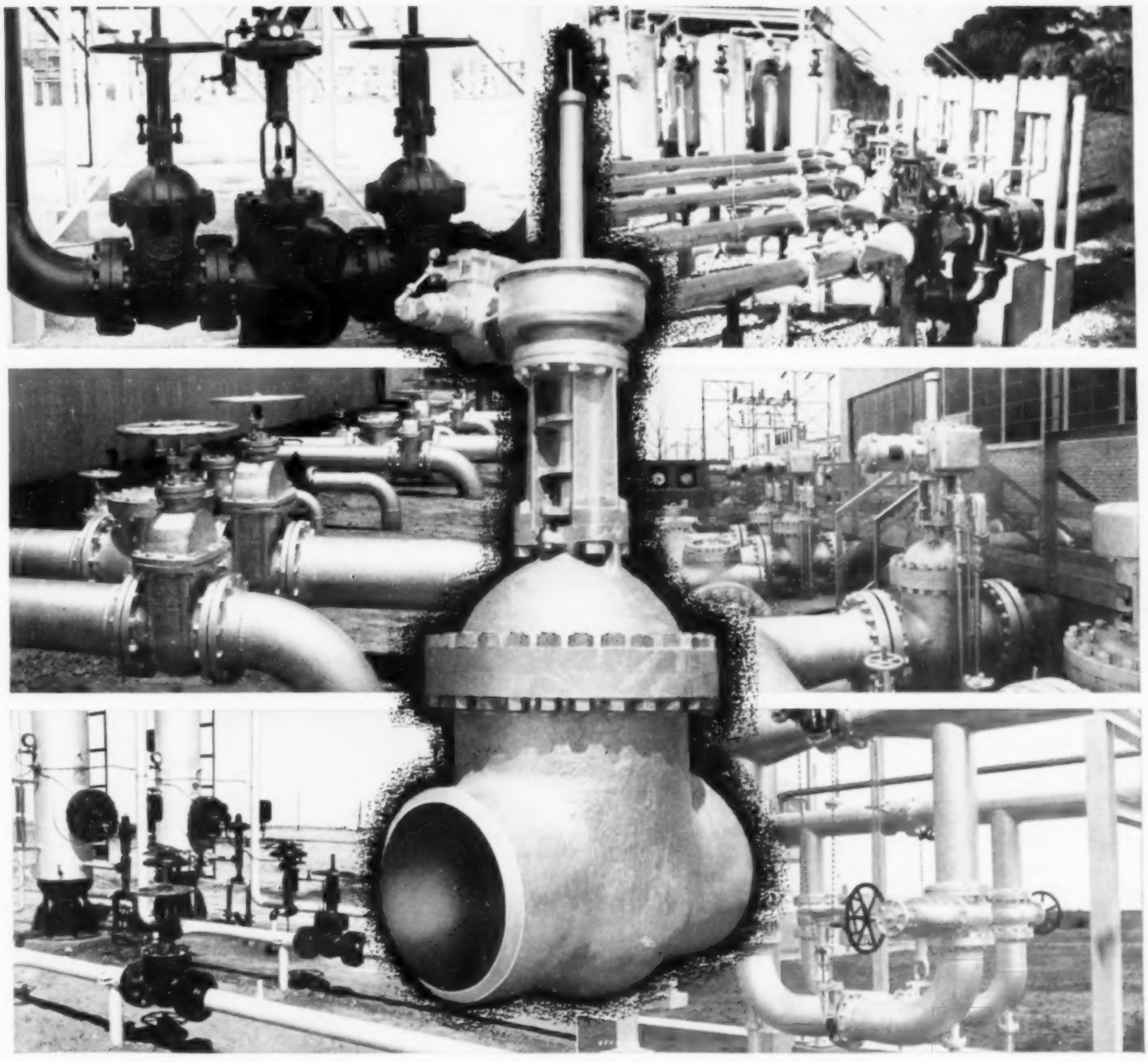
Laurel Will Construct Eastern Products Line

A 440-mile products line from Philadelphia to Pittsburgh to Cleveland will be built by Laurel Pipe Line Company, a new firm organized by Gulf Oil Corporation, Sinclair Pipe Line Company and The Texas Company.

The proposed pipe line's diameter will vary from 14 to 24 inches with more than 109 miles to consist of 24-inch diameter pipe. Estimated cost of the project is near $50 million.

Major construction of the line, requiring approximately 76,500 tons of pipe, is expected to begin in 1958. Plans call for the line to originate in the Philadelphia area. A tank farm to receive products from refineries supplying the line will be constructed at some Eastern seaboard site not yet selected.

For more data on advertised products, use Readers' Service Cards, last page.



Unmatched advantages whatever the service . . . with

Darling Fully Revolving Double Disc Parallel Seat Gate Valves

ALL the Darling gate valves shown here, from the large 30″ main line valve to small 4″ loading pump valves share identical multiple advantages. They operate with the positive yet easy closure . . . the uniform wear distribution . . . the elimination of disc-to-seat galling . . . the adjustment for valve body distortion . . . the minimum, simplified maintenance and the extended, trouble-free service life made possible by the well-proved fully revolving double disc gate principle perfected by Darling.

Why not check into Darling gate valves for your next requirements? Find out *how* they assure all these advantages . . . and let us give you proof! Write for Catalog No. 57.

DARLING VALVE & MANUFACTURING CO.

Williamsport 27, Pa.

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DARLING VALVES

PROPOSED PIPE LINE CONSTRUCTION

U. S. and International

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Buckeye Pipe Line Co., New York, 70 miles, 8 inch, products, from Wayne, Mich., to Durand, Mich., $2 million, planned.

Central Hudson Gas & Electric, Poughkeepsie, N. Y., 46 miles, 10-inch, gas, Albany to Kingston, N. Y., contract let to Williams-Austin Construction Corp.

Cities Service Gas Co., Oklahoma City, 116 miles, gas, facilities in Kansas and Oklahoma and pipe lines in Kansas, $11.4 million, authorized.

Cities Service Pipe Line Co., Bartlesville, 168 miles, 6-inch, products, from East Chicago, Ind., to Lowell, Mich, planned.

Coastal Transmission Corp., Houston, 565 miles, 20-26 inch, gas, from McAllen, Texas to Louisiana connection of Houston, Texas Gas and Oil plus 272 miles of laterals, $68 million, authorized.

Colorado Interstate Gas Co., Colorado Springs, 734 miles, 22-34 inch, gas, from Texas & Okla. Panhandle to Kit Carson, Colo., to Beatrice, Neb., $87 million, before FPC.

Deep Rock Gas Co., Oklahoma City, 120 miles, 6-inch, LPG, from Tioga, N. C., to Canadian border, planned.

El Paso Natural Gas Co., El Paso 439 miles, 6-34 inch, gas, facilities in Texas, New Mexico and Arizona to deliver gas to Southern Calif. Gas Co., Southern Counties Gas Co., and Pacific Gas & Electric Co., $107 million, before FPC.

43 miles, gas & products, facilities in Andrews and Ector counties, Texas, $5 million, contracts let.

El Paso Natural Gas Products Co., 240 miles, 8 inch, products, from Midkiff natural gasoline plant in Permian Basin to El Paso, planned.

Four Corners Pipe Line Co., Houston, 600 miles, 16 inch, crude, from Four Corners area to Los Angeles plus 150 miles of feeder lines, $50 million, planned.

Great Lakes Pipe Line Co., Kansas City, Mo., 84 miles, 8 inch, products, extension of system to Eau Claire, Wis., planned. 68 miles, 12 inch, products, from intersection of system with Badger Pipe Line into Chicago, planned.

140 miles, 8 inch, products, from company's terminal at Minneapolis to terminals at Superior, Wis., planned.

34 miles, 12 inch, from Tulsa to Barnsdall, Okla., planned.

14 miles, 8 inch, from Coffeyville to Independence, Kansas, planned.

11 miles, 8 inch, east of Great Lakes pumping station at Donahue, Iowa to Bettendorf, Iowa, planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20-inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, before FPC.

Iroquois Gas Corp., Buffalo, N. Y., 36 miles, gas, facilities in Chautauqua, Cattaraugus and Erie counties, N. Y., to develop new underground storage area, $2.8 million, contract let.

Laurel Pipe Line Co., Philadelphia, 440 miles, 14-24 inch, products, from Philadelphia to Pittsburgh to Cleveland, $50 million, planned.

Magna Pipeline Co., 40 miles, gas, underwater line from Anacortes, Wash., to Victoria, B. C., $6 million, planned.

Magnolia Pipe Line Co., Dallas, 220 miles, 12, 16-inch, crude, loops and additional equipment on Midland-to-Beaumont line, contract let to O. R. Burden Construction and H. B. Zachry Co.

Michigan-Wisconsin Pipe Line Co., Detroit, 472 miles, 4, 24-inch, gas, main line loops and extensions in Wisconsin, Illinois, $17.6 million, before FPC.

Midwestern Gas Transmission Co., Houston, 1112 miles, gas, from Emerson, Mont., to Nashville, Tenn., $98 million, before FPC.

Mountain Fuel Supply Co., Salt Lake City, 38 miles, 20 inch, gas, parallel line and facilities to transport gas from Pacific Northwest line in Sweetwater County, Wyo., $3 million, authorized.

Muskegon Pipe Line Corp., Detroit, 165 miles, 10 inch, crude, from Griffith, Ind., to Muskegon, Mich., planned.

Natural Gas Pipe Line Co. of America, Chicago, 350 miles, 20, 26 inch, gas, from Wise County, Texas to Fritch, Texas, $28.5 million. Some contracts let.

25 miles, gas, from Quinduno field in Roberts County, Texas, $3.2 million, authorized.

416 miles, 36 inch, gas, loops at various points along existing line, $76.2 million, before FPC.

337 miles, 30 inch, gas, loop line between company's terminus in Texas and Beatrice, Neb., $62.7 million, before FPC.

59 miles, 36 inch, gas, Beatrice to Joliet, Ill., before FPC.

North Carolina Natural Gas Corp., 630 miles, 2-16 inch, from Tranco's system near Mooresville across North Carolina, planned.

Northern Natural Gas Co., Omaha, 167 miles, 24 inch, gas, from Farmington, Minn. to Duluth, Minn., and Superior, Wis., $12 million, before FPC.

42 miles, 10 inch, gas, from Rochester, Minn. to Winona and Goodview, Minn., $963,000, before FPC.

365 miles, gas, new facilities in Minn., Iowa, S. D., Neb., Wis., plus 1090 miles of branch line and station facilities, $65.7 million, before FPC.

Northwest Pipeline Corp., Salt Lake City, 350 miles, 6-10 inch, crude and products, Four Corners area to Salt Lake City, $15 million, planned.

Ohio Fuel Gas Co., Columbus, 55 miles, 20, 24 inch, gas, line in Jackson and Gallia counties, compressor facilities at Crawford compressor station, Fairfield County, and pipe line from Crawford station to Licking County Ohio, planned.

Ohio Oil Company, Findlay, Ohio, 200 miles, products, from Wood River, Ill. to Chicago, planned.

Oklahoma Natural Gas Co., Tulsa, 16 miles, 8 inch, gas, to connect gas supplies in Gotebo field, Okla. to Clinton system in western Okla., $350,000, planned.

Pacific Gas & Electric Co., San Francisco, 223 miles, 34 inch, gas, various loops between Topock, Ariz. and Milpitas, Calif., $20 million, 85 miles let.

200 miles, 12 inch, gas, from northern Calif. gas fields to Humboldt County, Calif., $9.5 million, planned.

Pacific Northwest Pipe Line Corp., Salt Lake City, 50 miles, 4-6 inch, gas, to serve customers at Uravan and Nucla, Colo., $1 million, authorized.

1000 miles, gas, gathering system in San Juan Basin and sales laterals in Washington plus compressor facilities, $30 million, planned.

Pennsylvania Gas Co., Warren, Penn., 38 miles, 8, 10 inch, gas, in Erie and Warren Counties, Penn., and Chautauqua County, N. Y., $2.6 million, authorized.

Permian Basin Pipeline Co., Omaha, 83 miles, 16 inch, gas, facilities near Spraberry compressor station, Midland County, Texas to tie in with Pioneer gathering system, Schleicher County, Texas, $5 million, before FPC.

Piedmont Gas Co., Hickory, N. C., 78 miles, 2-8 inch, gas, from connection

with Transcontinental Gas Pipe Line to serve customers in North Carolina, $2.6 million, before FPC.

Salt Lake Pipe Line Co., Salt Lake City, 100 miles, 10 inch, crude, plus additional pumping facilities on Rangely to Salt Lake City line, planned.

80 miles, 8 inch, products, new line from Boise, Idaho, to Pasco, Wash., plus additional pumping facilities on Salt Lake City to Spokane line, planned.

Service Pipe Line Corp., Continental Pipe Line Co., Sinclair Pipe Line Co. and **Phillips Petroleum Co.**, products, from Salt Lake City to Spokane, Wash., considered.

Signal Oil & Gas Co., 80 miles, gas extension to gathering system in McKenzie County, N. D., contract let to C. P. Bartley & Son.

Skelly Oil Co., 38 miles, 8 inch, crude, gathering system extension from Nichols field to southern Kiowa County, Kansas, planned.

Southern Kansas Pipe Line Co., Inc., 200 miles, 6-10 inch, crude, southwestern Kansas to Arkansas City, Kansas, planned.

Southern Natural Gas Co., Birmingham, 52 miles, gas, various location in Georgia and Louisiana, $2.2 million, authorized.

Tennessee Gas Transmission Co., Houston, 100 miles, gas, gathering lines in Texas and Louisiana plus station additions, $18.6 million, authorized.

1085 miles, 12-30 inch, gas, Southeast Louisiana to Portland, Tenn.; from Kinder, La. to offshore wells in Gulf of Mexico; from Coudersport, Penn., to Hamburg, N. Y., and loop lines in Kentucky, West Virginia, Pennsylvania; compressor stations in Mississippi, Tennessee, New York, Pennsylvania; additions in Tennesse, Kentucky, Ohio, and Pennsylvania, $166 million, authorized.

Texas Eastern Transmission Corp., and **Texas Eastern Penn-Jersey Trans. Corp.**, 137 miles, 30 inch, gas, loops along line from Kosciusko, Miss., and Uniontown, Penn. and lateral supply lines plus additional compressor facilties to systems, $30.3 million, contract for 158 miles let to Houston Contracting Co.

Texas Illinois Natural Gas Pipeline Co., Chicago, 38 miles, 8 inch, gas, loop facilities in Illinois, $6.4 million, contract let.

Texas-New Mexico Pipe Line Co., Houston, 515 miles, 16 inch, crude, extension from Jal, N. M. pump station to Four Corners, $6.4 million, planned.

Transcontinental Gas Pipeline Corp., Houston, 287 miles, gas, loop lines and gathering laterals in Texas and compressor facilities in Louisiana, Mississippi, Alabama, Georgia, North Carolina and Virginia, $61.5 million, before FPC.

28 miles, 16 inch, gas, lateral in Cameron Parish, La., to take Transco's first offshore gas purchase, before FPC contract let to Sharman, Allen, Gay and Taylor.

Trust Pipe Line Co., Big Spring, Texas, 128 miles, 6 inch, products, from Abilene to Wichita Falls, Texas, $15 million, planned.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., considered.

United Gas Pipe Line Co., Shreveport, 40 miles, 8 inch, gas, from Baldwin County, Ala. to Container Corp. of America plant, Brewton, Ala., $1.2 million, authorized.

United Natural Gas Co., Oil City, Penn., 50 miles, 12 inch, gas, from Elk County to Jefferson County, Penn., planned.

Washington Gas Light Co., Washington, D. C., 28 miles, 20, 24 inch, gas, from metering station of Atlantic Seaboard Corp. to Washington to connect with line leading to District of Columbia facilities, $3.4 million, authorized.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., Bella Coola, B. C., considered.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Andes Pipeline Corp., 500 miles, 12 inch, gas, from Villamontes, Bolivia, to Antofagasta, Chile, $30 million, planned.

Bolivian Gulf Oil Co., 201 miles, 8-10 inch, crude, from Sicasica, Bolivia, to Arica, Chile, $10.5 million, planned.

British Petroleum Company, London, 16-inch, crude, from Popton Point, South Wales to Llandarcy refinery, $14 million, considered.

Caltex Pacific Oil Co., 30 miles, 30 inch, crude, Linking Duri and Bekasap oil fields in Sumatra to terminal on coast at Dumai on Malacca Strait, contracts let to International Bechtel.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Creole Petroleum Corp., Caracas, Ven., 94 miles, 28 inch, crude, from Temblador to Caripito, Venezuela, $5.6 million, planned.

Empresa Nacionales de Petrolco, Chile, 75 miles, 10 inch, products, from government refinery at Concon to Santiago, planned.

Gaz de France, 550 miles, 12-24 inch, gas, main line from Lacq field to Paris plus 450 miles of branch lines to Lyons, Nantes and Chateaurous, planned.

Gibson Crude Oil Purchasing Co. Ltd., 22 miles, 6 inch, Calgary, crude, from Bellshill Lake oil field in Alberta to tie in with Interprovincial's pump station near Hardisty, contract let to Hutchison Construction Ltd.

International Petroleum Co., Talara, Peru, 180 miles, crude, Pasto, Colombia to Pacific port of Tumaco, considered.

Iraq Government, 150 miles, gas, from Kirkuk field to Baghdad, considered.

Iraq Joint Venture Pipe Line, 1200 miles, 36-40 inch, crude, from head of Persian Gulf through Iraq to Turkish coast of Mediterranean, $840 million, planned.

Mene Grande Oil Co., Caracas, Ven., 62 miles, 30 inch, crude, from Anaco to Puerto La Cruz, Venezuela, $5.8 million, contract let.

National Iranian Petroleum Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

North-West Pipelines Co., 233 miles, 28 inch, crude, from Wilhelmshaven on North Sea to Ruhr area of Germany, $47 million, contract let.

Petroargentina, Bahia Blanca, Argentina, 370 miles, 16 inch, crude, from Newguen to Bahia Blanca, Argentina, $40 million, planned.

Petroleos Mexicanos, Mexico City, 440 miles, 20 inch, gas, Brazil-Tampico-Poza Rica, Mexico, planned.

145 miles, 12 inch, crude, from 18 de Marzo field to Monterrey, considered.

80 miles, 8 inch, products, from Guaymas to Los Mochis, $1 million, planned.

150 miles, 22-inch, gas, from Monterrey to Reynosa to tie into Texas Eastern system, planned.

Royalite Oil Co., Calgary, 350 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, planned.

Saskatchewan Power Corp., Regina, Sask., 80 miles, gas, Hatton gas field to Success, Sask., planned.

Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (S.N. Repal) and **Compagnie Francaise des Petroles**, Algeria, through Sahara Desert of Algeria, through Tunisia to Lybian border, considered.

Stanmount Pipe Line Co., 140 miles, 10 inch, crude, Cayiga and Beaver Lake fields, N. D., to connect with Interprovincial Pipe Line, planned.

Sturgeon Pipe Line Co., 100 miles, 12-inch, Sturgeon Lake field to Trans-Mountain system, $6.5 million, planned.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

Trans-Canada Pipe Line, Ltd., Calgary, Alta., 2250 miles 36 inch, gas, Alberta to eastern Canada, $378 million; contracts let for 10 spreads.

Trans-Europe Pipe Line, 500 miles, 30 inch, crude, from Mediterranean to northern Europe, considered.

Union Gas Co. of Canada, 142 miles, 26 inch, gas, Dawn storage area to Hamilton, Ont., plus branch lines, planned.

Westcoast Transmission Company, Ltd., Calgary, 270 miles, 8-26 inch, gas, various locations in Peace River region, contracts let for 155 miles.

174 miles, 30-inch, gas, Savanna Creek gas field, Alberta, to British Columbian border, planned.

Westspur Pipe Line Co., 20 miles, 12 inch, crude, Alida to Carnduff-Glen Ewen area of Saskatchewan plus 34 miles of gathering line, planned.

Winnipeg and Central Gas Co., Winnipeg, Mant., 450 miles, 4-8 inch, LPG, from Tioga, N. D. to Winnipeg, Canada, $20 million, planned.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 1056 miles, 24-inch, gas, Campo Duran to Buenos Aires, Argentina, $76 million, planned.

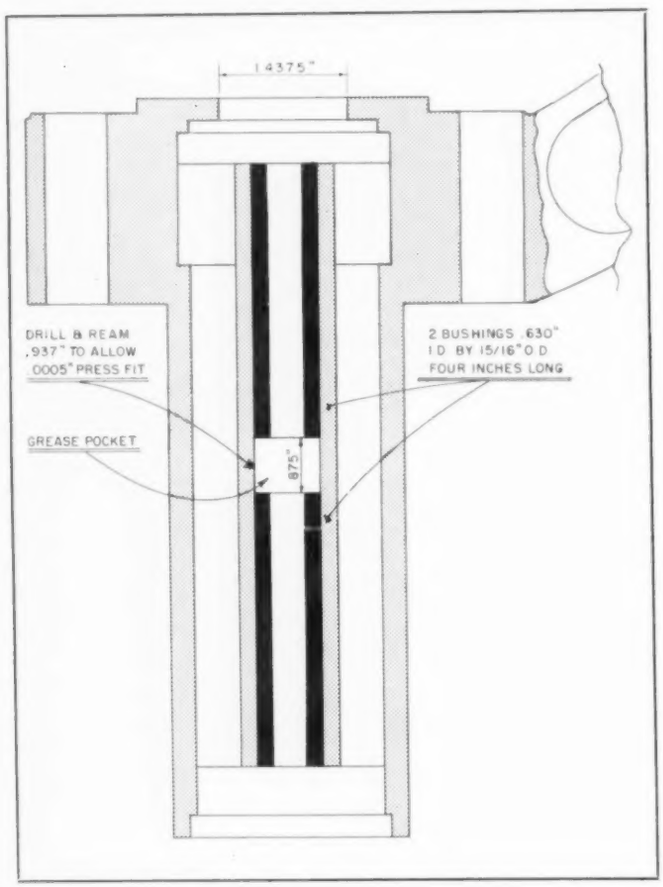
621 miles, crude, Mendoza to San Lorenzo, Argentina, $19 million, planned.

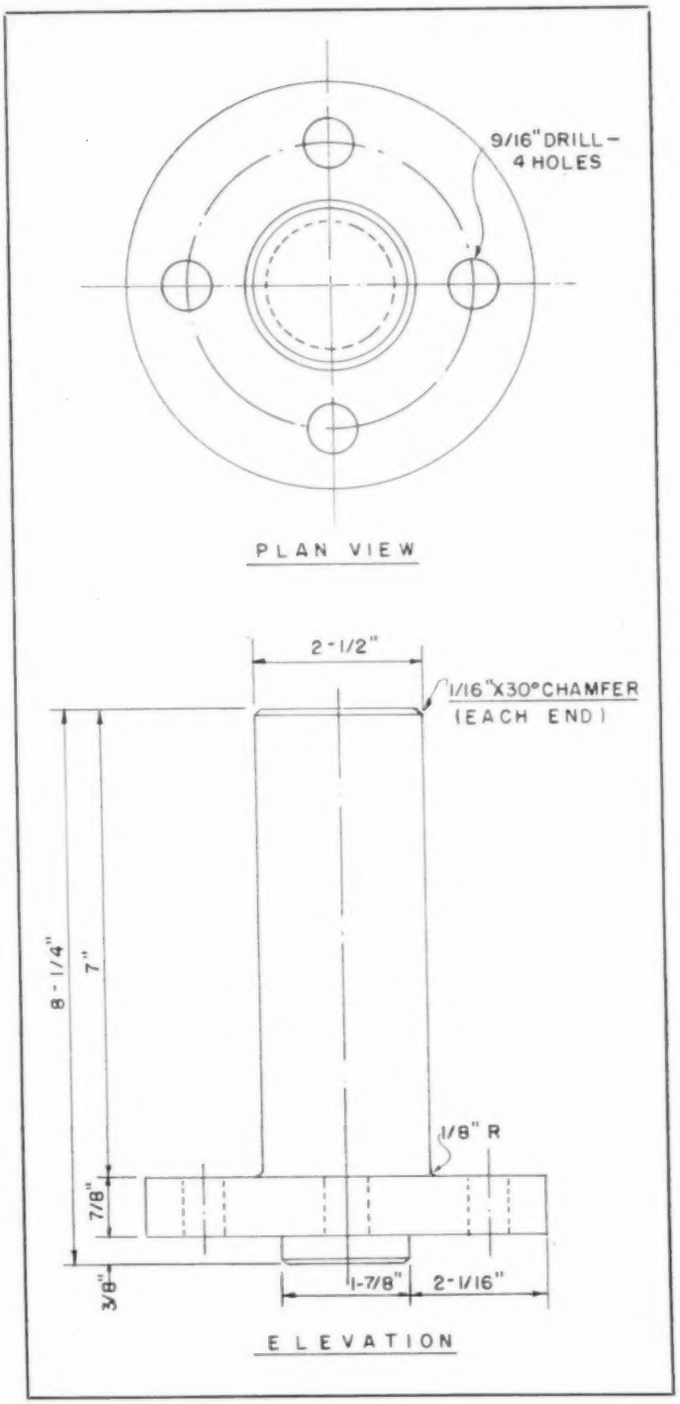
Yacimientos Petroliferos Fiscales Bolivia, La Paz, 86 miles, crude, from Yacuiba to Bermejo, Bolivia, $3 million, considered.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas





Salvage Worn Fuel Injection Valve Bodies

One company has developed a method of salvaging worn fuel injection valve bodies for compressor engines by machining them and thus permitting insertion of stem guide bushings. The process has saved this company over $2000 at the present time. Previously, valve stems wearing on the stem guide bores resulted in frequent valve burning.

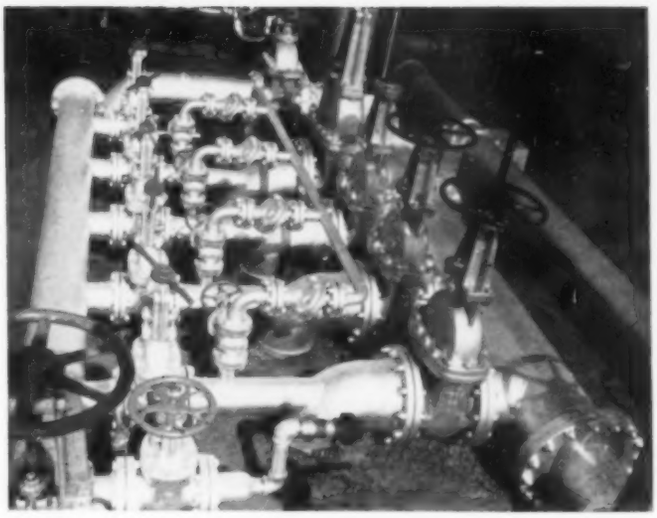
Because no repair parts were available, the following procedure was adopted in repairing the worn parts. A machinist enlarged the old, worn, valve guides and inserted two bushings in the enlarged valve guides, leaving a grease pocket between them (see drawing above). The original valve stem guide was of cast iron, and the repair bushings made of steel. The repair job is anticipated to last at least three times as long as the original installation.

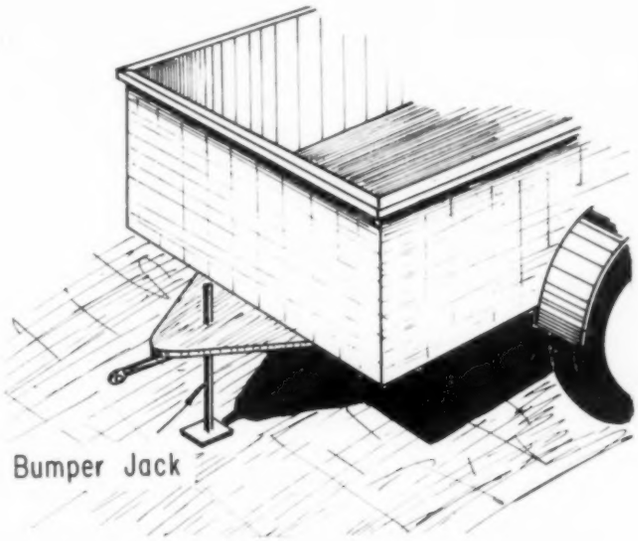
Under this procedure there is no apparent limit as to the number of times new bushings can be placed in a worn valve body. When wear eventually makes replacement necessary, it can be done by simply pressing out the old guide bushings and pressing in new ones. A valve body can be salvaged by this procedure at the approximate savings of $50 per valve body.

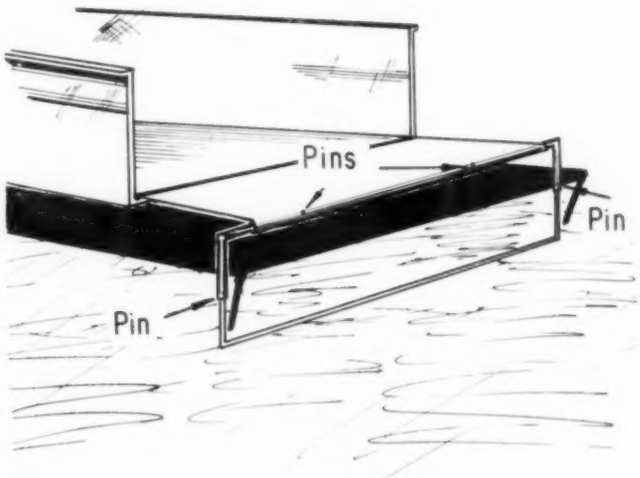
Fresh Water Line Used To Purge Manifold System

The water system shown here facilitates the task of purging lines with fresh water before connection work or displacement of various grades of crude.

The water line is tied in between the two valves on each header, allowing displacement in either direction by manipulation of the proper valves. This system has a check valve installed before each water-connection valve and adds to the over-all safety features by eliminating connection work around wasted crude.



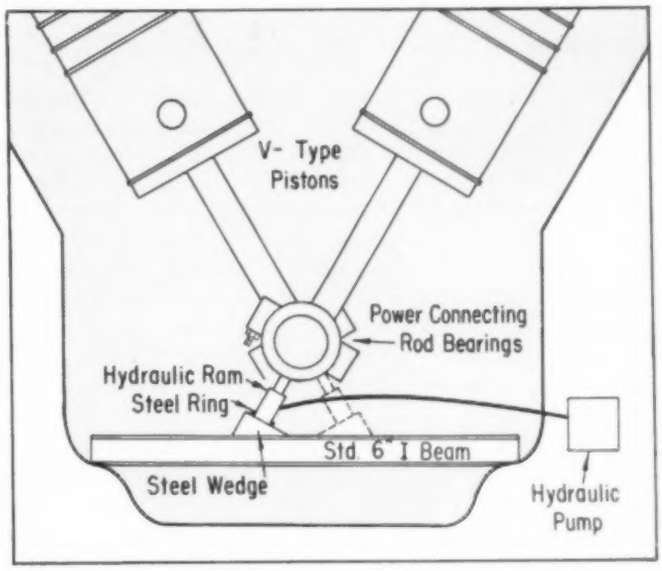




Pumping Unit Trailer Can Have Adjustable Legs

With a few feet of junk pipe, a welder can install adjustable legs for a portable pumping unit trailer. The front of the trailer can be equipped with an ordinary automobile bumper jack for additional adjusting. The "tail-gate" can be fixed with telescoping pin-held legs.

These telescoping legs and bumper jack will shorten the set-up time required when installing a trailer mounted unit. A more stable and safer installation will result.



Check Rod Bearing Clearance With I-Beam and Wedges

To overcome the difficulties in supporting a jack or ram at the proper angle to apply pressure in line with the piston on a V-type engine, this I-beam and wedge set-up can be a time-saver.

A short section of I-beam cut to fit the size of engine can be set across the inside base over the oil sump. A steel wedge is made, having the same angle as the cylinders and wide enough to accommodate the base of a small hydraulic ram. Weld ears on the bottom of the wedge, curved to lap around the top of the I-beam. This holds the wedge in place but allows it to be moved up and down the beam.

The wedge is spotted on the beam at the correct location and held in place by steel pins dropped through corresponding holes in the ears and I-beam. These holes are located by scribing and drilling, after fitting the I-beam inside the engine.

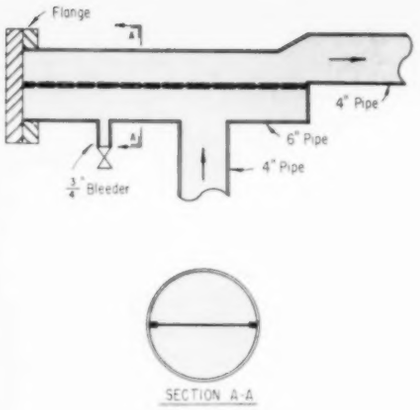
A magnetic base dial indicator is used in conjunction with this set-up to read the clearance between the bearing surfaces as the hydraulic ram removes the slack in the bearings.

Accessible Tool Rack on Gang Truck Leaves Tools Easy to Reach and See

Convenient tool rack adds to the accessibility of tools in a gang truck by putting them where they can be seen and reached easily. By having a place for everything, the pusher can tell at a glance whether he has collected all the tools after a job.

A ledge about 14 inches wide is constructed across the back of the cab with a small tool box for hand tools mounted on top of it at the left side. In the center, a hand winch is mounted with a snatch block and chain for loading heavy equipment. On the right side, a water can is mounted with a well for an oil can just behind it.

Two-inch pipe nipples are welded on the edge of the ledge. These make convenient places to hang the larger tools such as the cheater, hammers and crescents.

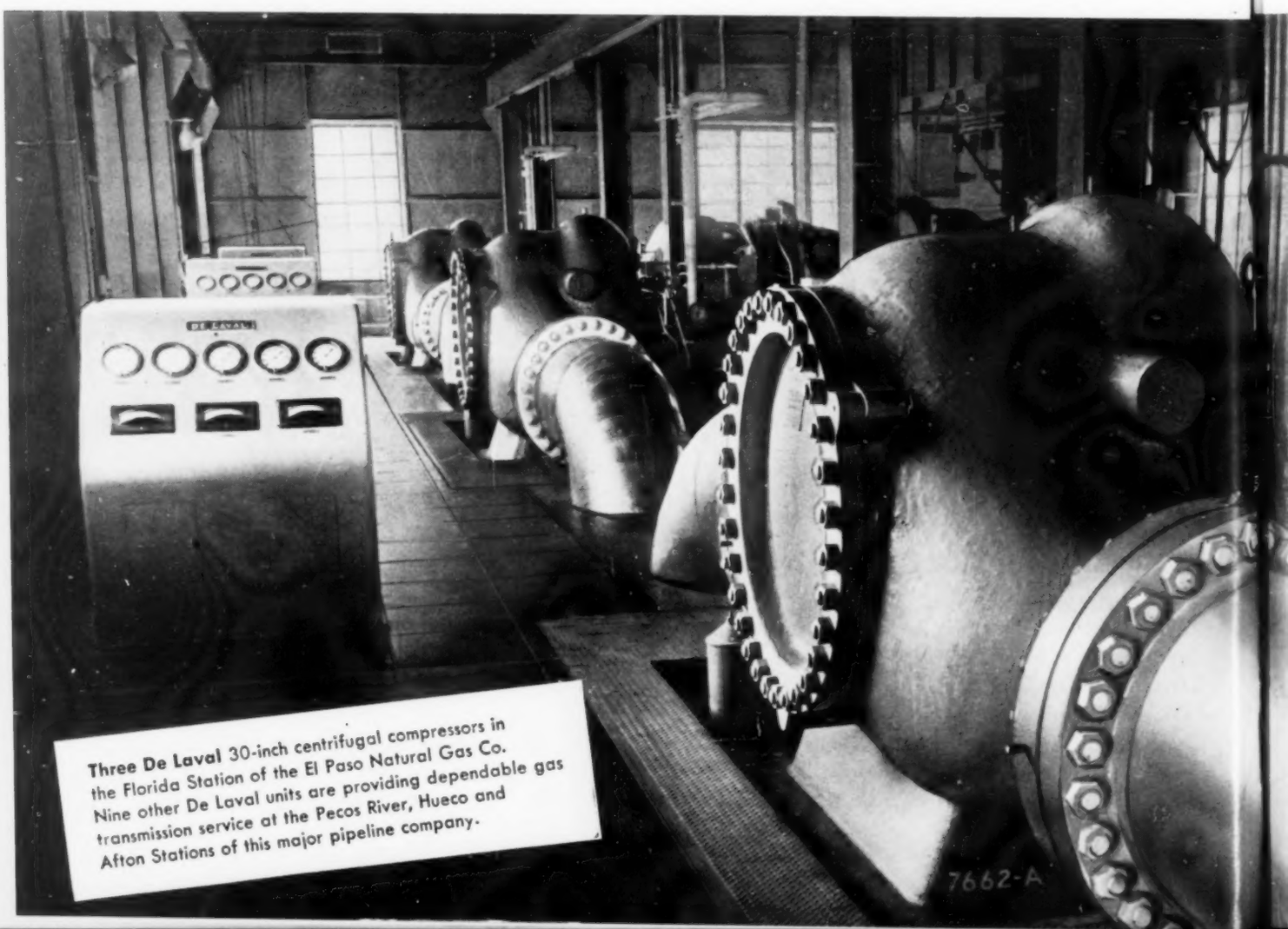


Shopmade Strainer Improves Truck Unloading Facilities

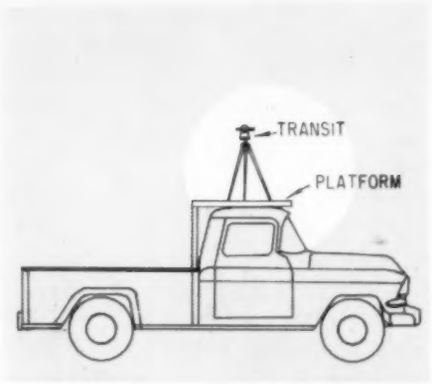
This shopmade strainer can be easily built into the truck unloading facilities, using pup-joints of ordinary line pipe.

The strainer, acting as a combination bleeder tank, can be easily cleaned and inspected by the removal of a single flange. Foreign matter is prevented from entering the pump, thus allowing smoother over-all operations.

This installation can be used when unloading lines are manifolded by using vertical risers above ground.



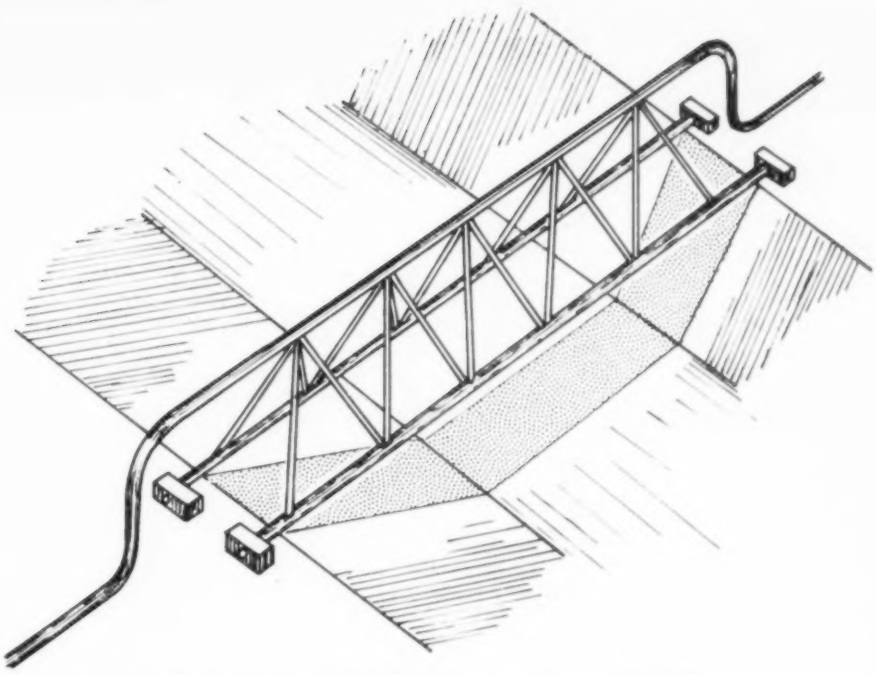
Three De Laval 30-inch centrifugal compressors in the Florida Station of the El Paso Natural Gas Co. Nine other De Laval units are providing dependable gas transmission service at the Pecos River, Hueco and Afton Stations of this major pipeline company.



Truck Platform Useful In Preliminary Survey

For preliminary or maintenance-type surveys, a platform can be installed on top of a pick-up truck to give the instrument man added visibility. The platform, built out of 2 by 12's and mounted on a headache rack, will allow the approximate projection of the line by use of back sights and angles without costly damage to crops.

This installation could prove valuable in both locating an old line or in rough surveys for estimating purposes. Compass bearings will not be accurate under these circumstances.



Line Assists Itself Across Small Rivers

A company in Koahsiung, Formosa, uses this bridge-type support for crossing several small 80 feet—110 feet rivers with a 6-inch jet fuel line.

This scheme uses the 6-inch trunk line as part of the bridge to conserve steel. In addition to easier construction and maintenance, the bridge does not tie up valuable farming land on the crowded island with large concrete foundations.

A crossing like this can result in considerable savings on a stream not subject to boat traffic. Overhead-type construction aids maintenance painting and inspection.

DE LAVAL

CENTRIFUGAL COMPRESSORS

on the job at El Paso Natural Gas

De Laval centrifugal compressors offer many important engineering features. (1) They are designed to handle an increased ultimate flow, can be quickly converted to larger capacities by replacing the impeller, diaphragm and a few minor parts. (2) The high pressure shaft seal eliminates leakage, consumption of sealing oil is negligible. (3) There is only one moving part—the rotor—which has ample clearance. (4) Units are compact, require smaller foundations and smaller stations. (5) First costs and installation costs are low.

Bulletin 503 gives data on De Laval Centrifugal Compressors. Write for your copy.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

884 Nottingham Way, Trenton 2, New Jersey

DL375

Transporting

Replacing

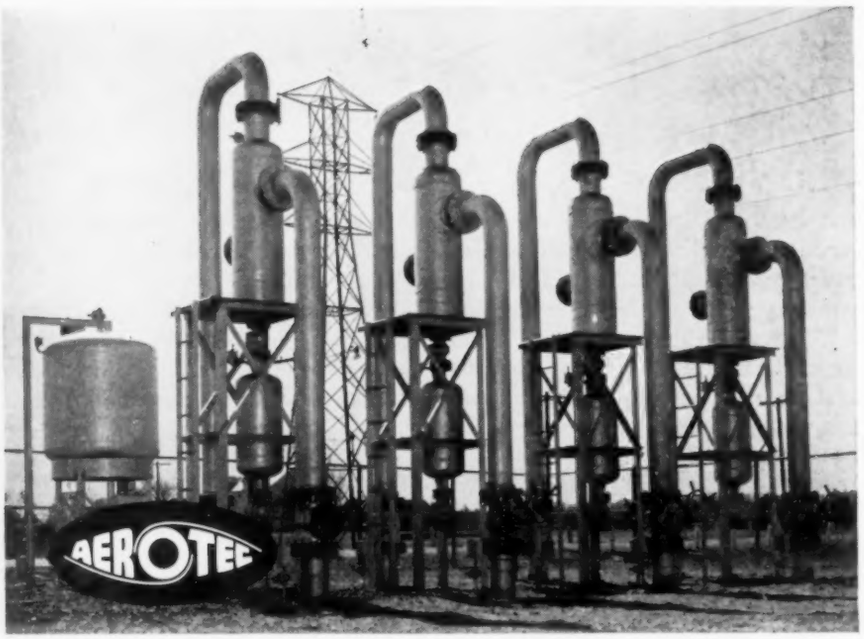
Headache Bar Is Pole Setting Aid

The headache bar shown here doubles as a pole-setting aid, enabling one man to replace a 20-foot to 35-foot pole safely, in case of an emergency.

The crossbar is constructed so that when placed in the front position, it is about three inches higher than the cab. This allows the pole to be transported to the job site without damage to the truck.

When replacing a broken pole, the rig is set in the rear stake holes, with the hinged loop holding the pole to the crossarm. The loop is made of ⅝-inch sucker rod, and is attached to hinge-type pins. These pins fit into holes drilled in the two-inch pipe crossarm.

When only one pole needs replacement, this device can save considerable time and money, as one man can make emergency repairs safely, at any location.



cleaning gas without wetting agents

These four Aerotec Gas Scrubbers, operating in parallel, were installed by a large utility to clean the gas at the entrance to the Albany, New York distributing station.

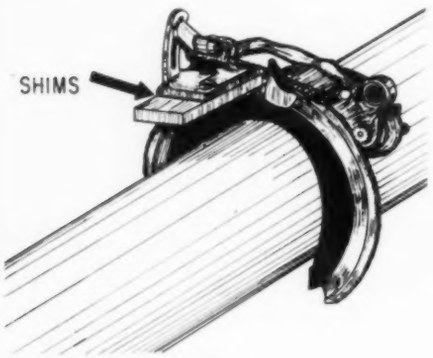
Dry clean gas is a necessity at this critical point, and these units have been serving the community for several years with no liquid carry-over. They operate on the principle of centrifugally removing solid and liquid contaminants from gas, a method in use for many years in dust control.

Aerotec Dry Gas Scrubbers are serving the industry on practically every major gas line today. Their outstanding performance presents an unexcelled record and their comparatively small size simplifies installation in limited space.

Our Project Engineers have a background of experience in solving gas scrubbing problems that will be valuable to you.

Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.
(Offices in 38 principal cities)
Canadian Affiliates: T. C. CHOWN, LTD., 164 Metcalfe Ave., Westmount, Montreal 6, Que.

Manufacturers
THE AEROTEC CORPORATION
Greenwich, Conn.



Shims Tilt Torch, Help Remove Scale

To allow the flame on a bevelling machine to get under the scale and "blow" it out of the way, one welder used this novel idea.

Shims were placed .035 to .050 inches under the forward side (in direction torch travels) of the torch plate. This action tilted the torch through an angle perpendicular to the long axis of the pipe. The guides on the torch plate were not affected, as the amount of shim stock used did not elevate the torch plate sufficiently to lose contact.

Tilting the torch this small amount aided the removal of scale, before burning actually took place. The bevelling angle was not affected, and much re-bevelling of pipe was avoided.

PROVEN DRAGSHOVEL PERFORMANCE
Now in Popular New Size

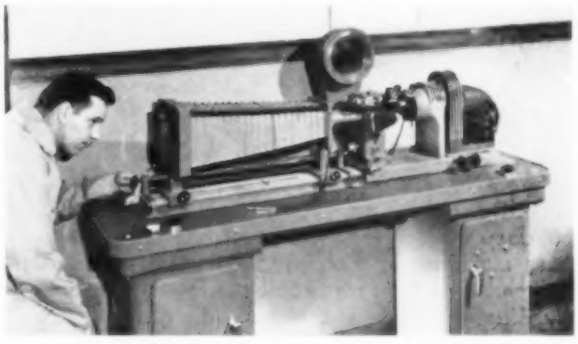
BUCYRUS ERIE

1-yd. 30-B

The outstanding performance of the Bucyrus-Erie 15-B and 22-B dragshovels on pipeline construction now is available in the 1-yard class with introduction of the new 30-B.

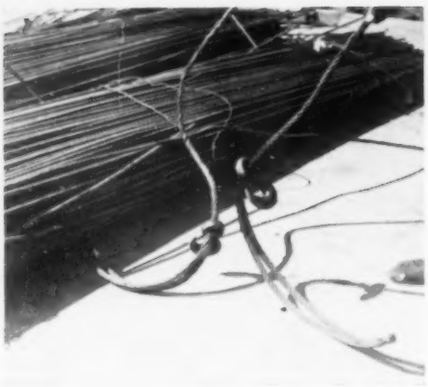
The 30-B is available with either diesel or gasoline power, direct or torque converter drive. It features easy air controls; strong, rigid cast-steel revolving frame; large, cool-running clutches and brakes; and optional independent propel. Three widths of trench dippers are available. Side cutters are available for the trench type dippers as extra equipment to give additional cutting widths. Dippers have cast lips fitted with two part teeth. Especially useful to pipeliners whose work often puts them on very rough terrain is a telescopic strut between the auxiliary A-frame and the cab which serves as a safety against kick-back when working on steep grades.

Your nearby Bucyrus-Erie distributor will be pleased to give you all the details on this new 1-yd. 30-B dragshovel. Contact him soon.



Bonus Quality—The texture and physical makeup of all metals used in Bucyrus-Erie equipment is an important determinant of their strength and durability. Here a metallographic microscope is being used to check the structure of a sample of metal and photograph it to provide a permanent record. 383E57

BUCYRUS-ERIE COMPANY
SOUTH MILWAUKEE, WISCONSIN



Double Loop

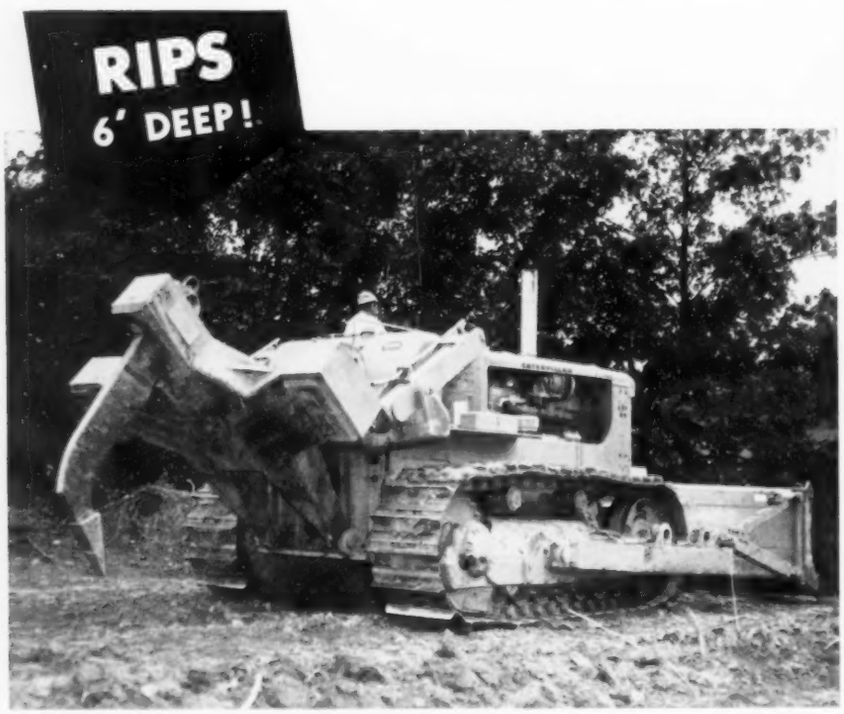
Spliced Cable Loop Gives Smooth Unloading

In handling bar stock, pipe or other bundles of material for pipe line construction, the placing of the hook can help or hinder the loading procedure.

One company moves the hook about four feet up from the end of the line and secures it there by a splice. The hook is held in place by bending the end of the wire line back and splicing it to the main length of line—giving a double loop approximately 2 to 2½ feet in length.

When unloading cumbersome bundles, the loop is slipped under a bundle with the end of the loop caught by the hook. After unloading, the loop can easily be unhooked and the sling pulled out from underneath the pile.

This method eliminates lost time and prevents the hook from catching on the bottom of the bundle during removal.



C-R-C KELLEY RIPPER

The C-R-C Kelley Ripper, D-9 Caterpiller size, rips 6' deep through laminated rock ahead of the ditching machine, with savings in time and cost per ditch. Hydraulic or cable-operated C-R-C Kelley Rippers are available also in sizes to fit D-8 and D-7 class tractors. Write or call Crutcher-Rolfs-Cummings, Inc., at 7825 Katy Road, Houston, Texas, UNderwood 4-6391.

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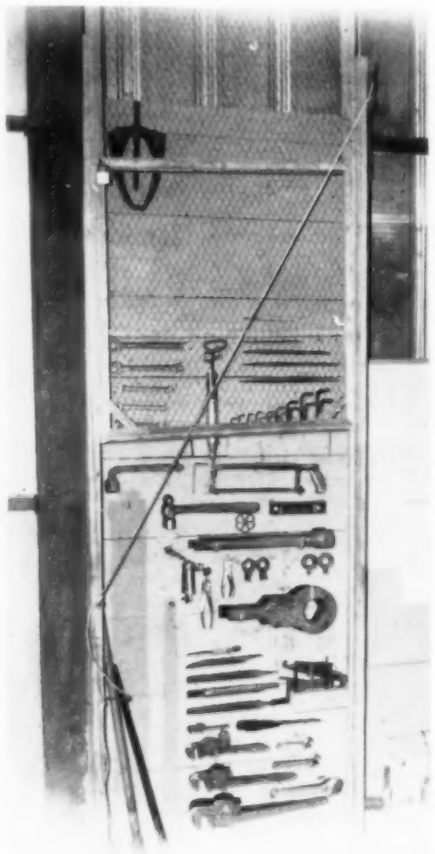
7310 99th St., Edmonton, Alberta, Canada



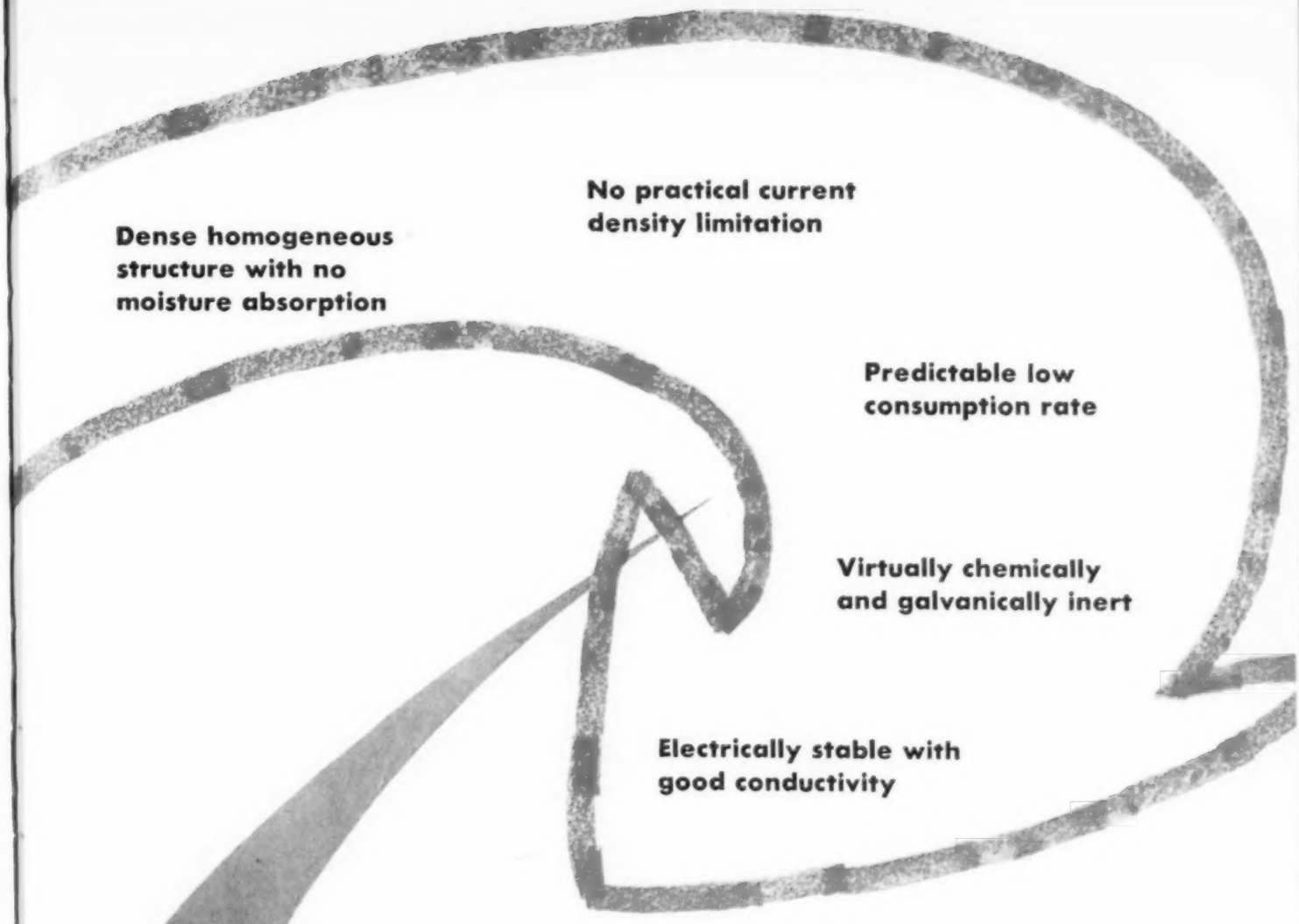
Protect Tools With Chicken Wire Cover

This chicken wire cover, framed by scrap angle iron or molding, is used to protect valuable tools from pilferage.

An "indexed" tool board is easily accessible during working hours, but is as easily accessible for unauthorized personnel during off-hours. With a frame and sash cord, much like a conventional window, the protective door is easily lowered or raised. A hasp and lock at the bottom complete the assembly.

Authorized foremen or maintenance men can be issued proper keys to assure the correct supply of tools at all times.

For more data on advertised products, use Readers' Service Cards, last page.


No practical current density limitation
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Everything points to

DURIRON®

DURCO

Impressed Current

ANODES

for cathodic protection

THE DURIRON COMPANY, INC., DAYTON, OHIO

Pipe Line Men

IN THE NEWS

Mark V. Burlingame

George P. Garver

J. J. Hedrick, president of Natural Gas Pipeline Company of America and of Texas Illinois Natural Gas Pipeline Company, has been elected president of **Peoples Gas Light & Coke Company.** Hedrick succeeds **Eskil I. Bjork**, who has been named chairman and chief executive officer of Peoples Gas and board chairman of the pipe line companies. Succeeding Hedrick as president of the affiliated pipe line companies will be **George P. Garver**, who is presently vice president and secretary-treasurer of the pipe line companies. Hedrick will fill the new office of vice chairman of the board of directors of the pipe line companies. **Mark V. Burlingame**, presently vice president in charge of operations, fills a new position as executive vice president of the pipe line companies.

•

Curtis M. Smith, vice president of the Tennessee Gas Transmission Company, was chosen to head the **Southern Gas Association** at the 14-state organization's recent convention in New Orleans. Smith's election as president was the first for a representative of an interstate natural gas pipe line company during the SGA's 49-year history. He succeeds **R. A. Puryear, Jr.**, president of the Alabama Gas Corporation, Birmingham.

Curtis M. Smith

Other new officers include **Carl E. Cloud** of the MidSouth Gas Company, Little Rock, first vice president; **O. W. Clark** of the Southern Natural Gas Company, Birmingham, second vice president; **R. L. Hinch** of the Nashville Gas Company, Nashville, secretary; **Kyle H. Turner** of the Atlanta Gas Light Company, Atlanta, assistant secretary, and **Willard G. Wiegel** of the Lone Star Gas Company, Dallas, treasurer. The last two men were re-elected to their offices.

•

Magnolia Pipe Line Company has announced the election of **Stanley L. Westlake** and **David H. Levy**, both of Dallas, to the company's board of directors. Westlake is chief engineer and Levy is general superintendent of the Communications and Electrical department. Other actions taken at the meeting of the board of directors included election of **Fred H. Pennington**, Dallas, as treasurer of Magnolia Pipe Line, and of **L. E. Frensley**, Dallas, as comptroller of the pipe line company. **Clarence S. Cone** was named assistant comptroller.

•

Platte Pipe Line Company has added two new members to the board of directors. **J. H. Renard**, Sinclair Pipe Line Company, Independence, Kansas, succeeds **J. D. McConnell** of Sinclair and **A. W. Tarkington**, Continental Oil Company, Houston, succeeds **T. A. van Griethuysen** of Continental.

Members re-elected to the board include **K. A. Covell**, The Pure Oil Company; **Karl T. Feldman**, Sinclair Pipe Line Company; **R. E. Kepke**, The Toronto Pipe Line Company; **W. L. Kygar**, Continental Pipe Line Company; **Jack H. Rice**, The Ohio Oil Company; **W. G. Sexton**, The Toronto Pipe Line Company; **R. F. Sturgis, Jr.**, The Pure Oil Company; **D. R. Williams**, The Ohio Oil Company and **R. F. Moore**, Platte Pipe Line Company.

•

Claude F. Horton has been elected executive vice president and a member of the board of directors of **Construcciones Collins de Venezuela.** Horton also was named assistant to **S. V. (Sammy) Collins** in contract negotiations for Collins Construction Company of Port Lavaca. Formerly Horton was vice president of Brown & Root, Inc. in charge of pipe line construction.

Claude F. Horton

•

Jack B. Owens will replace **G. Byron Smith** as controller of **Pacific Northwest Pipeline Corporation.** Owens has been assistant controller at Pacific Northwest since 1955. Smith resigned recently. Prior to joining the company, Owens had been associated with a pipe line construction company and an accounting firm in Houston. His new headquarters are at Salt Lake City, Utah.

•

Pacific Northwest Pipeline Corporation recently named **Donald L. Anderson** to supervise gas purchases for the company. Anderson has been with Pacific Northwest since 1952 and was district manager of the Pacific Land department prior to his recent promotion.

•

R. L. (Bob) Topper has been named executive assistant to **E. Clyde McGraw**, executive vice president of **Transcontinental Gas Pipe Line Corporation. Howard L. Cline** will succeed Topper as Transco's assistant chief engineer and **John C. Boehm** will assume Cline's position of superintendent of compressor stations. The new assistant superintendent of compressor stations replacing Boehm is **F. M. (Tanny) Wright.** Wright has been superintendent of Transco's Compressor division III with headquarters at Charlottesville, Va. The men will now have headquarters in Houston.

•

Northern Natural Gas Producing Company has named **J. M. Barton** vice president. Formerly exploration manager, Barton joined Northern Natural Gas Producing in 1953 after 15 years of experience with Magnolia Petroleum Company, the Cooperative Refinery Association of Wichita and Deep Rock Oil Company. In his new capacity Barton reports to **John M. Hanley**, vice president of Northern Natural Gas Company and the subsidiary producing company.

J. M. Barton

•

United Gas Corporation has announced the promotion of two Shreveport men. **Fred M. Odom, Jr.**, has been elected a vice president and **B. M. Byrd** has been named secretary. Odom will move into the vacancy created by the promotion of **J. H. Miracle** who was recently elected treasurer and also continues as a vice president. Byrd succeeds the late **B. H. Winham.**

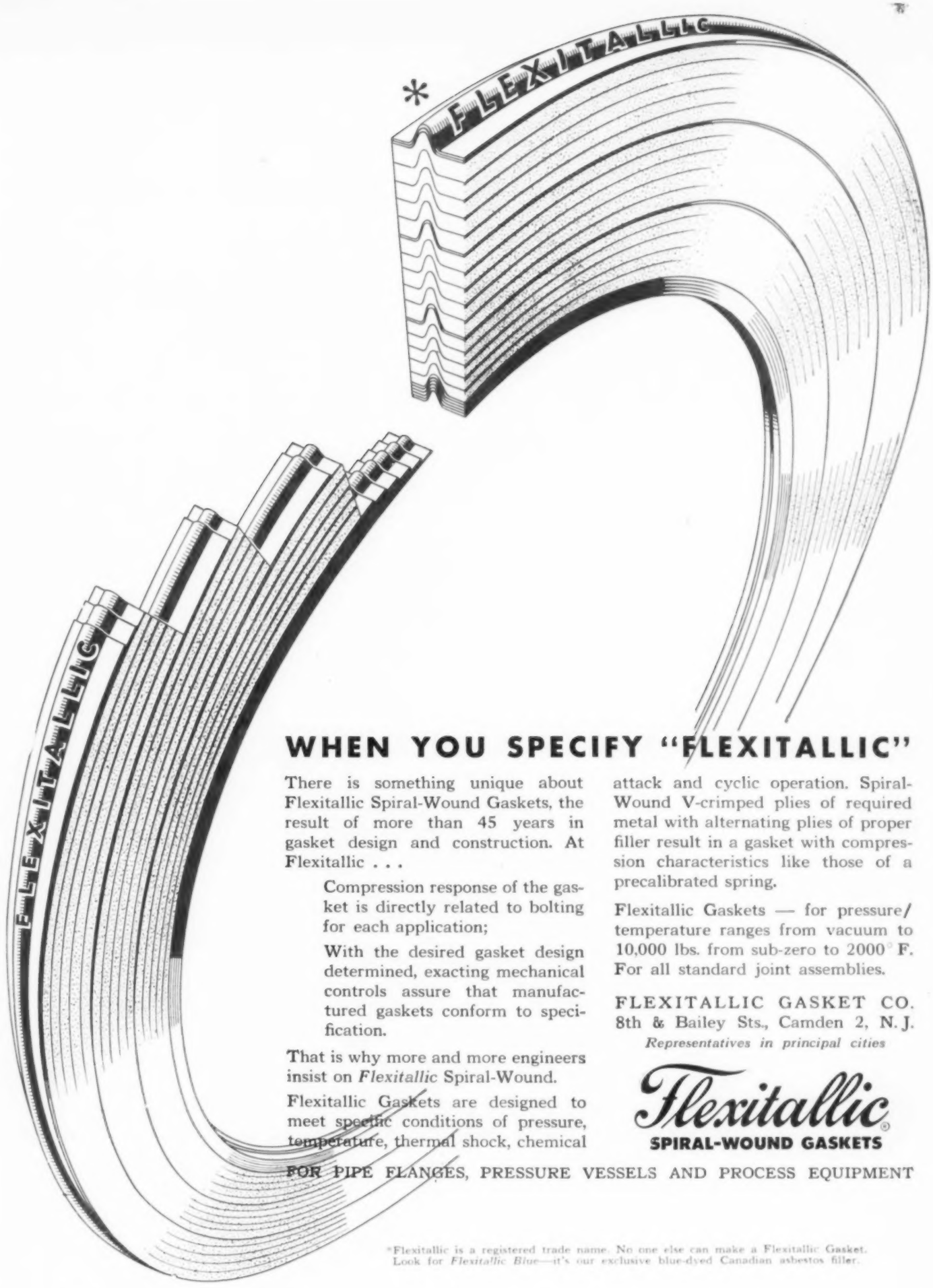
Odom joined United Gas in 1936 and has held the position of executive secretary to **N. C. McGowen**, president, since 1947. Byrd has been with United Gas for 18 years and was named assistant secretary in 1956.

•

El Paso Natural Gas Company has announced two promotions. **C. C. Selly** has been named construction superintendent and will direct all plant and pipe line construction activities. Selly joined El Paso Natural in 1934 as a construction laborer. **T. O. Norfleet** has been promoted to assistant construction superintendent and will have control over all the company's pipe line construction activities. Norfleet has been with the company since 1940 when he worked as a laborer in pipe line construction.

•

Cities Service Pipe Line Company recently named **B. D. Leuty** as president. Leuty joined the company in 1924 and has been serving as manager of pipe line transportation and vice president of Cities Service Pipe Line Company. Elected with him are **Harry Nelson**, vice president and manager; **G. R. Preston**, vice president treasurer; **G. C. Richardson** and **R. E. Roehl**, vice presidents and **O. W. Bailey**, secretary.



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There is something unique about Flexitallic Spiral-Wound Gaskets, the result of more than 45 years in gasket design and construction. At Flexitallic . . .

Compression response of the gasket is directly related to bolting for each application;

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That is why more and more engineers insist on *Flexitallic* Spiral-Wound.

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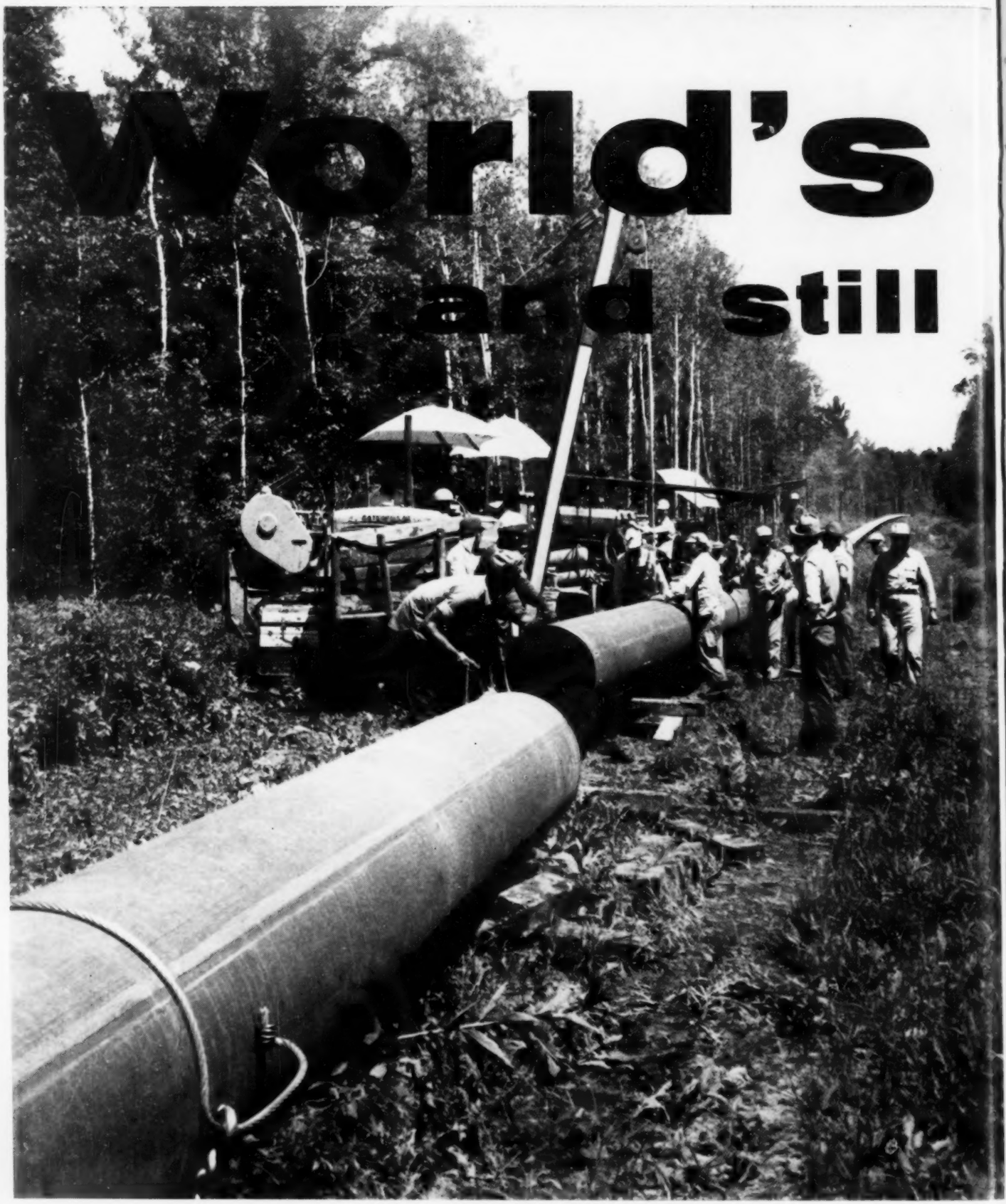


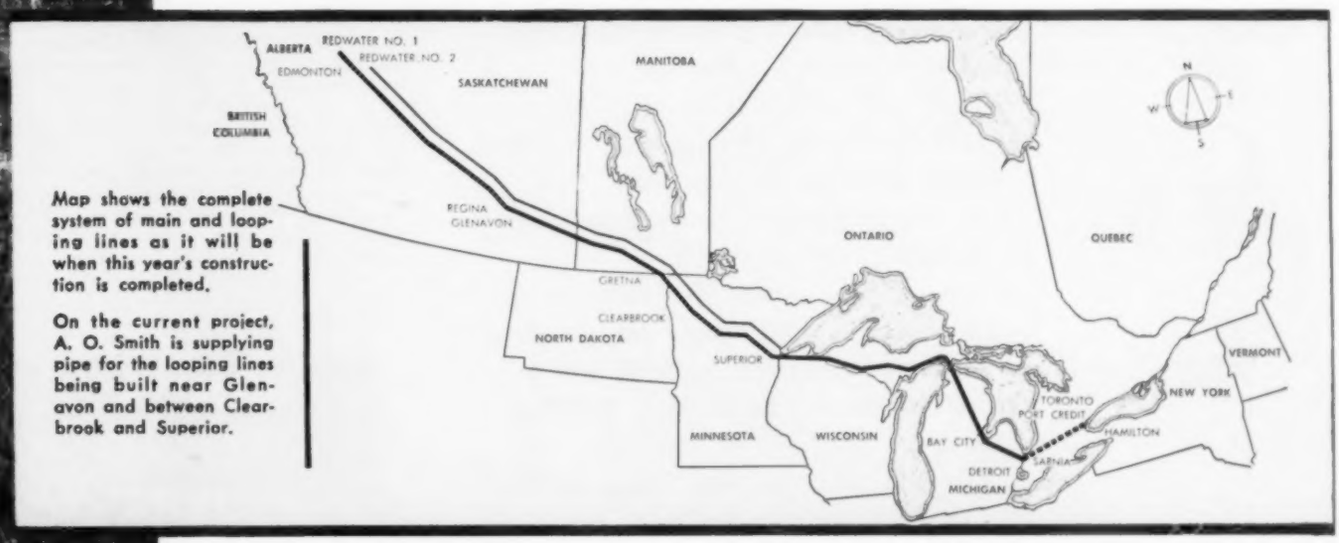
Interprovincial has extended their system from Superior to Sarnia and now from Sarnia to Port Credit, Ontario by the end of this year. It will then include over 3,000 miles of main line and loops. A. O. Smith's contribution to the system will be just above 50% of the total line laid.

longest growing!

Interprovincial Pipe Line Company has 1,774 miles of main line now in service . . . will extend this system another 156 miles during '57

THIS is the big crude oil carrier from Edmonton, Alberta, to refineries in the Prairie Provinces and Ontario in Canada . . . Minnesota, Wisconsin and Michigan in the U. S. Spanning 1,774 miles, it's already the world's longest line of this type and construction is now under way that will increase main line length to over 1,900 miles.

A. O. Smith is proud to have been a part of this great system since the original main line of 1129 miles was constructed in 1950. Over 70% of this original line to Superior, Wisconsin was supplied by A. O. Smith. Since that time from both Milwaukee and Houston mills, A. O. Smith has supplied most of the pipe for the looping work done on this original section in 1953, 1954, 1956 and 1957.



Map shows the complete system of main and looping lines as it will be when this year's construction is completed.

On the current project, A. O. Smith is supplying pipe for the looping lines being built near Glenavon and between Clearbrook and Superior.

For almost 30 years...

A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely-controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is in nearly every important high-pressure line.

Through research ... *a better way*

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W-S Forged Steel Fittings

Now protected with...

new blue rustproof coating

That attractive color you see on our forged carbon steel fittings is a new synthetic coating that effectively protects the fittings against corrosion in stock and in service. The coating completely covers the fittings—inside and outside, thus protecting threads and sockets, as well as external surfaces.

If you are going to paint your piping system for color coding or other reasons, the new coating serves as an excellent base for paint. No objectionable rust or scale to scour off before painting.

All W-S forged carbon steel fittings, in both screw-end and socket-welding types, are now available with the new blue rustproof coating.

Remember the blue color. It labels the fitting a W-S Quality Product.

Send for your copy of Forged Steel Fittings Catalog A-3-56

Write to W-S Fittings Division, H. K. Porter Company, Inc., P.O. Box 95, Roselle, N. J.

HKP W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.

N. John McNeill

Robert C. Berry

N. John McNeill has been named vice president and secretary of **Trans-Canada Pipe Lines Limited** and **Robert C. Berry**, appointed vice president and treasurer. McNeill and Berry are in the Toronto office of Trans-Canada.

•

R. H. Christman

Fred W. Zilm

R. H. Christman, contracting administrator for **Service Pipe Line Company**, has been promoted to civil engineer and **Fred W. Zilm**, former welding technician, is promoted to contracting administrator. Christman replaces **K. N. Bradley**, who has been promoted to senior engineer.

•

Texas Gas Transmission Corporation has announced the election of **W. M. Elmer** as executive vice president. Elmer, former senior vice president, will take over his new duties immediately and will continue to serve as president of **Texas Gas Exploration Corporation** and as a director of both corporations. He has been an officer of Texas Gas since 1948 when he was elected comptroller.

WHO'S MEETING WHERE

June

ASME, Semiannual Meeting, Sheraton-Palace Hotel, San Francisco, June 9-13.

ASTM, Chalfonte-Haddon Hall, Atlantic City, N. J., June 16-21.

Association for Computing Machinery, 12th Annual Meeting, Houston, June 19-21.

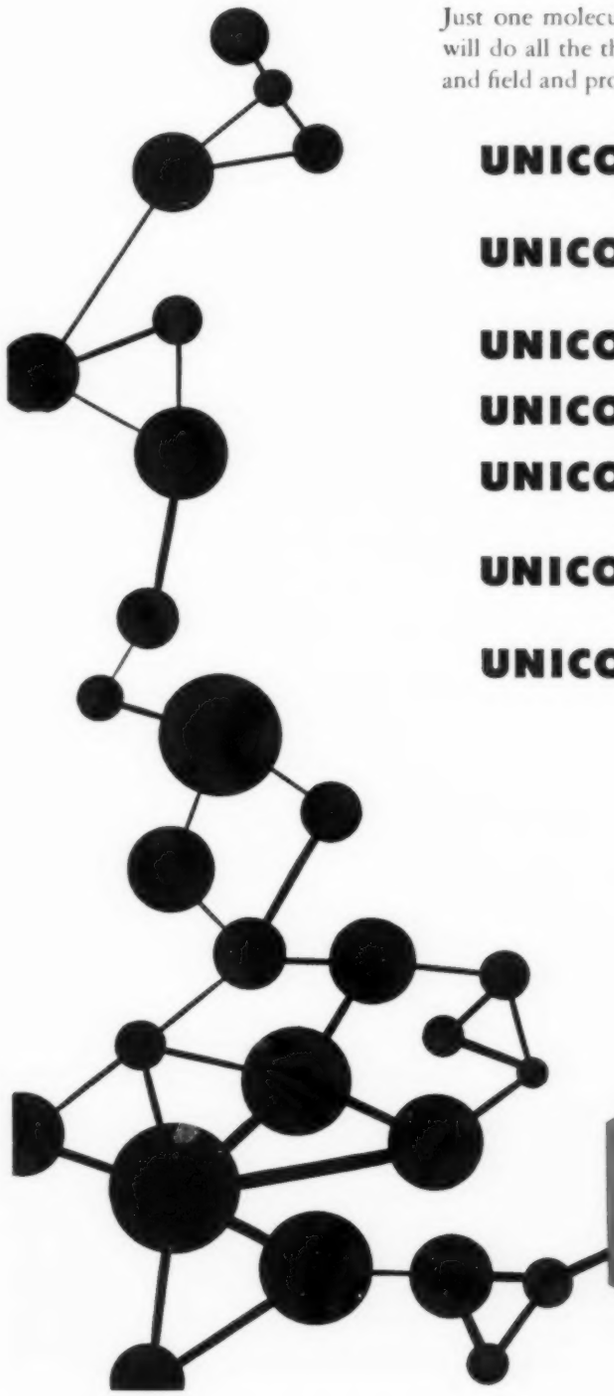
Canadian Gas Association, 50th Annual Meeting, Jasper Park Lodge, Jasper, Alberta, Canada, June 23-27.

Michigan Gas Association, Grand Hotel, Mackinac Island, Mich., June 24-25.

American Institute of Electrical Engineers, Sheraton-Mt. Royal Hotel, Montreal, Canada, June 24-28.

For more data on advertised products, use Readers' Service Cards, last page.

1 in a million!



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UNICOR® prevents both aerobic and anerobic corrosion. Your tanks, vessels and pipelines are protected whether full, half-full or empty.

UNICOR is oil soluble and eliminates need for addition of destructive water. It prevents rusting caused by unavoidably entrained or dissolved moisture.

UNICOR is slime-detergent and anti-fouling. The water-repellent film it forms on pipe interiors sheds corrosive droplets.

UNICOR cuts downtime to a minimum, reduces filter replacement and the use of scrapers by at least one-half.

UNICOR will not interfere with action of other useful additives such as tetraethyl lead, antioxidants and dyes. It is approved for use in Air Force and Navy jet plane fuel.

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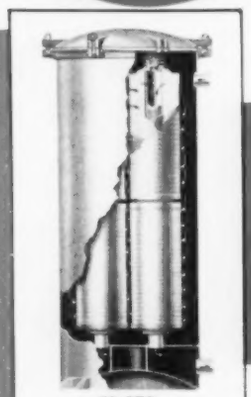

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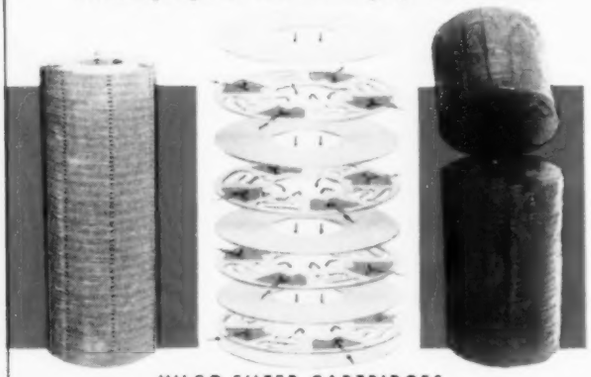
Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.



HILCO FILTER CARTRIDGES

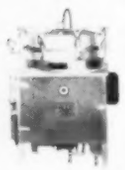
The result of much research in the field of lubricating, fuel and industrial oil filtration, the new patented HILCO Filter Cartridges meet the need for tremendous filtering area, low pressure drop and high dirt storage capacity. Above: Fig. 1 is a new cartridge; Fig. 2 is a used cartridge (note that pockets are completely filled and the outer surface covered with solids); Fig. 3 shows the flow of oil, the dark area represents dirty oil passing into the pockets while filtered oil (white area) passes into "S" shaped section.

HILCO Purification Means *Complete* Oil Purification . . .

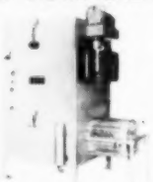
You get absolute removal of sludge, acids, carbon, water and fuel dilution with a properly selected HILCO. Clean oil saves you money. Expensive maintenance is reduced, equipment shut-downs practically eliminated, lost man hours and cuts in production become a thing of the past. HILCO continuous, all electric, automatic purification keeps your oil clean and in top condition at all times. You receive the full capacity and economy of your equipment.

HILCO offers a wide range of oil purification units to meet every oil conditioning problem. HILCO units are manufactured in both stationary and portable models. Write us about your purification needs . . . recommendations are given with no obligation. Let HILCO put its 25 years of experience in oil purification to work for you.

THERE'S A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM



Oil Reclaimer



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August

Appalachian Gas Measurement Short Course, 17th Annual Meeting, West Virginia University, Morgantown, W. Va., August 26-28.

September

Pacific Coast Gas Association Convention, Fairmont and Mark Hopkins Hotels, San Francisco, Sept. 3-5.

New Jersey Gas Association, Annual Meeting, Spring Lake, New Jersey, Sept. 6.

Independent Natural Gas Association of America, Annual Meeting, Shamrock Hilton Hotel, Houston, Sept. 9-10.

AIEE, Annual Meeting, Penn-Sheraton Hotel, Philadelphia, Sept. 9-11.

Electrical Conference of the Petroleum Industry, AIEE Petroleum Industry Committee, Penn-Sheraton Hotel, Philadelphia, Sept. 9-11.

National Petroleum Association, 55th Annual Meeting, Traymore Hotel, Atlantic City, N. J., Sept. 11-13.

Midwest Gas Association, Gas School and Conference, Iowa State College, Ames, Iowa, Sept. 11-13.

12th Annual Instrument-Automation Conference and Exhibit, Auditorium, Cleveland, Ohio, Sept. 11-15.

Southeastern Gas Association Convention, Robert E. Lee Hotel, Winston Salem, North Carolina, Sept. 18-20.

ASME, 12th Annual Petroleum Mechanical Engineering Conference, Mayo Hotel, Tulsa, Sept. 23-25.

American Society of Mechanical Engineers, Petroleum Mechanical Engineering Conference, Mayo Hotel, Tulsa, Sept. 23-25.

Mid-Continent Oil and Gas Association Louisiana-Arkansas Division, Roosevelt Hotel, New Orleans, Sept. 26-27.

October

Texas Mid-Continent Oil & Gas Association, 38th Annual Meeting, Texas Hotel, Fort Worth, Oct. 1-2.

NACE, North Central Region, Sherman Hotel, Chicago, Oct. 1-4.

NACE, South Central Region, City Auditorium, Oklahoma City, Oct. 1-4.

The Society of Petroleum Engineers, AIME, 32nd Annual Fall Meeting, Adolphus, Baker and Statler Hilton Hotels, Dallas, Oct. 6-9.

American Gas Association, Kiel Auditorium, St. Louis, Mo., Oct. 7-9.

AIEE, Morrison Hotel, Chicago, Oct. 7-11.

NACE, Western Regional Conference, U. S. Grant Hotel, San Diego, Oct. 22-24.

November

API, 37th Annual Meeting, Conrad Hilton Hotel and Palmer House, Chicago, Nov. 11-14, 1957.

National Association of Corrosion Engineers, Fall Meeting of Northeast Region, Penn-Sheraton Hotel, Pittsburgh, Nov. 12-14.

WHY NOT LET BrakeSolve YOUR PARAFFIN Problem?

BRAKESOL is the safe, economical way to clean up and control paraffin in your production system. By using BRAKESOL, you get more production, by reason of having unrestricted flow and by avoiding those tank bottoms.

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Houston, Texas	HOmestead 5-6648
Lovington, New Mexico	6-5954
New Iberia, Louisiana	EMerson 9-3498
Odessa, Texas	FEderal 7-2630
Pampa, Texas	MOhawk 9-9994
Edmonton, Alberta, Canada	8-4815
Oklahoma City, Okla.	WH 9-5561
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Wayne A. Johnson, president, and his associates in Corrosion Rectifying Company, Inc., are well-known corrosion prevention specialists with offices in Houston. Their work is concentrated on designing and installing corrosion rectifying systems for pipelines, refineries and oil producing companies.

Here, in convenient reference form, are timely articles on corrosion prevention systems by a well-known specialist in the field. Send for your free copies, giving name, company and title.

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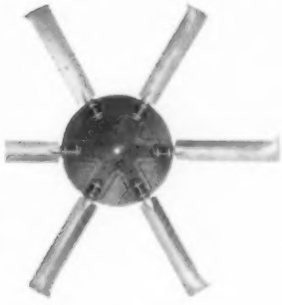

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Developed originally for the petroleum industry, Aerovent Large-Diameter "Al-metal" Propellers, constructed of tough, durable aluminum alloy, move great quantities of air at high velocities, in heat exchangers and cooling towers. Pictured above are two 4-blade, 16-ft. propellers in a cooling tower installation. These mighty propellers, with adjustable-pitch "Macheta" Airfoil blades, are job-engineered to individual specifications.

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DESIGNED FOR DEPENDABLE OPERATION!

Endurance tests, conducted at *3 times* normal loading prove the ability of these new large-diameter propellers to withstand severe punishment. Heavy-duty cast steel hubs offer maximum resistance to stresses. Angle settings for each operating requirement, and appropriate alternate settings, assure accurate pitch for any predetermined performance which may be required. 54" to 144" now available in revolutionary new "T-Alloy".

REFINERIES, pumping stations, industrial plants and commercial buildings use Aerovent "Al-metal" Propellers in major air-moving applications.

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...AND THE WORLD OVER

KERN SURVEYING INSTRUMENTS

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WORLD FAMOUS FOR
Working Speed
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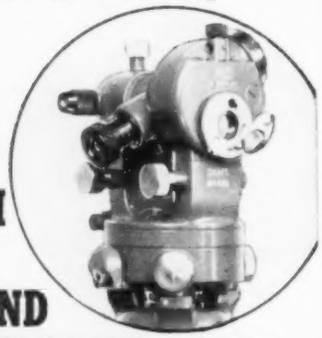

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- Exceptional portability and precision.
- Readings automatically ... AT A GLANCE.
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- Can be used with electric lighting unit for night work.

KERN CENTERING TRIPOD

Unique—a Kern first! Centers instruments in seconds with remarkable accuracy. Assures exceptional stability with ball-and-socket head, supporting instrument coupling.

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120 Grand St., White Plains, N.Y.

What's Happening

AMONG SERVICE AND SUPPLY MEN

E. J. Schwanhausser

Walther H. Feldmann

Worthington Corporation Elects President and Vice Chairman

The board of directors of Worthington Corporation announced the election of Walther H. Feldmann as president, succeeding Edwin J. Schwanhausser, who becomes vice chairman. Hobart C. Ramsey continues as chairman and chief executive officer.

Feldmann was first associated with Worthington in 1944 as president and general manager of Electric Machinery Mfg. Company, which became a part of Worthington that year. He was elected vice president of Worthington in charge of sales in 1950, and executive vice president in 1955. He has been a member of the board of directors since last September.

Schwanhausser joined Worthington in 1915 in the Engineering department of the Harrison, N. J. Works. Prior to becoming president, he was elected vice president in 1939, vice president in charge of sales in 1945, and executive vice president in 1949. He has been a member of the board of directors since 1942.

Wallace Joins Walworth As Vice President-Engineering

John C. Wallace has been named vice president of engineering for the Walworth Company. Wallace was formerly vice president and general manager of Hunt-Spiller Manufacturing Corp., Boston.

Wallace was previously associated with Lima Hamilton Corp. and the Bessemer & Lake Erie Railroad.

Johnson Is Sales Engineer For Tod Pazdral Pipeline

J. H. (Jerry) Johnson has been appointed sales engineer for Tod Pazdral Pipeline Specialties of Houston. Johnson, with many years of experience in oil and gas construction engineering, will serve the Louisiana, Mississippi and East Texas area.

Raybestos-Manhattan Builds Adhesives Testing Laboratory

A new laboratory has been constructed by Raybestos-Manhattan, Inc. at its plant in Stratford, Conn., for the development and testing of the line of Ray-Bond adhesives, coatings and sealers made by its Adhesives department.

The equipment includes tensile machines for shear and peel tests, ovens for testing up to 600° F., pilot mixers, salt spray testing cabinets and humidity testing area. The latter permits testing the drying time and other properties of adhesives under a great variety of climatic combinations.

The Adhesives department also has access to the facilities of the analytical laboratory in Raybestos-Manhattan's Stratford plant.

Koehring Appoints Three Arkansas, Ohio Distributors

Koehring, division of Koehring Co., Milwaukee, Wis., has named three new distributors to handle sale and service of Koehring division trade-mark products in Arkansas and Ohio.

The new distributors include the McDonald Equipment Company, Little Rock, Ark. The territory includes nearly all of Arkansas. Company president is Roy L. McDonald.

The Central Ohio Tractor Company, Columbus, Ohio, has a territory composed of 37 counties in Ohio. President of the company is A. J. Barry.

The Minneapolis-Moline Company of the Eastern Industrial division in Cleveland, Ohio, lists a territory of 18 counties in Ohio. J. M. Cottrell is the division manager.

Maintenance Engineering Opens Shreveport Office

Maintenance Engineering Corporation of Houston has announced the opening of a new sales office in Shreveport, La., to supply service to customers in the Arkansas-Louisiana-East Texas areas.

David R. Carroll

David R. Carroll has been appointed manager of the new Shreveport office. Carroll joined Maintenance Engineering in 1953 as sales and service engineer, after working with Humble Pipe Line Company as a corrosion engineer and with a core analysis firm.

Crose Manufacturing Co. Purchases Houston Plant

M. J. Crose Manufacturing Co., Tulsa, has purchased the complete facilities of Cinch Pipe Bending Co. of Houston. The plant has been designated the Cinch Division of M. J. Crose Manufacturing Co. and Crose's divisional headquarters are in Houston. Ben C. Montgomery continues as division manager.

Chicago Bridge & Iron Co. Promotes Boberg and Marcoux

I. E. Boberg, chief engineer of the Chicago Bridge & Iron Company, has been elected a vice president. Leo J. Marcoux, controller, was elected secretary.

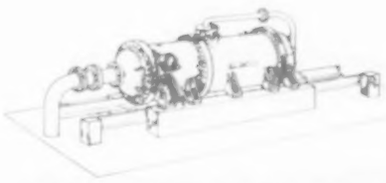
Boberg began working for the Chicago firm in 1924. He left in 1927 to work in the consulting field, returning in 1935. During World War II, Boberg was in charge of all engineering and construction

More than 325,000 horsepower of

I-R CENTRIFUGAL COMPRESSORS

for NATURAL GAS SERVICE

I-R *"FIRSTS"* in Centrifugal Gas Compressor History

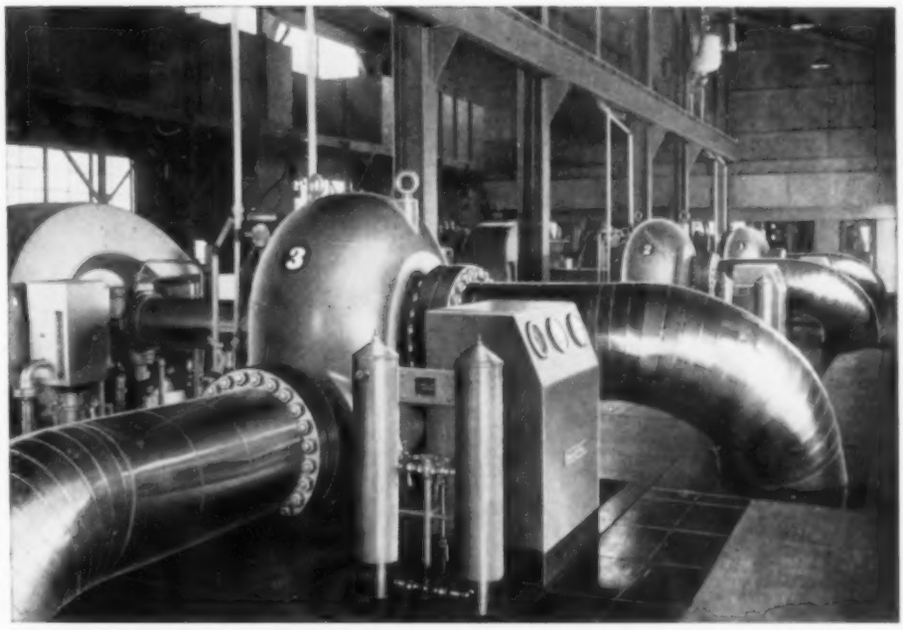


FIRST CENTRIFUGAL PIPE-LINE COMPRESSOR Built by Ingersoll-Rand in 1931, this centrifugal pipe-line booster consists of a six-stage compressor driven by a 3550 rpm, 3000 hp motor, all encased in a pressure vessel.

FIRST COMMERCIAL APPLICATION of centrifugal pipe-line compressors was made in 1947. A total of 78 electric-motor-driven, single-stage I-R centrifugals were installed, to handle approximately 250 mmcfd.

FIRST GAS-TURBINE-DRIVEN UNIT Installed in 1949, this Ingersoll-Rand centrifugal compressor, powered by an 1850 hp simple cycle combustion gas turbine, was the first gas-turbine-driven centrifugal compressor developed and applied to pipeline service, and was designed for a flow of 192 mmcfd at a ratio of 1.18.

FIRST 2000 PSI CENTRIFUGAL GAS COMPRESSOR This Ingersoll-Rand 5000 hp double-case centrifugal compressor was the first unit ever built for handling natural gas at a discharge pressure of 2000 psi.



Three of 8 Ingersoll-Rand centrifugal compressors installed on a large natural gas pipe-line. Each unit is driven by a 5000 hp gas turbine.

This experience means MAXIMUM DEPENDABILITY in modern pipe-line service

FROM the very first pipe-line installation, Ingersoll-Rand has pioneered in the development of centrifugal gas compressors for higher and higher capacities and pressures. And every step of the way, dependability of performance has been a prime consideration in every detail of design and construction. This is why more I-R Centrifugal Compressors have been sold for natural gas service than any other make . . . . a total exceeding 325,000 hp for this service alone.

Backed by such long and successful experience, the modern I-R centrifugal gas compressor is your best assurance of trouble-free performance and long-range economy in gas transmission service.

Ingersoll-Rand

11 Broadway, New York 4, N. Y. 12-319

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS CONDENSERS
CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

For more data on advertised products, use Readers' Service Cards, last page.

STOPPLE APPLICATION
HOT TAPPING
PIGGING
BUSHINGS & INSULATORS

Agent for T. D. Williamson, Inc.

MARKER VENTS
AERIAL MARKERS
WELL MARKERS
SAFETY SIGNS

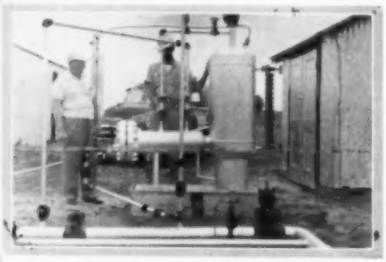
Sole Distributors for L & M Co.

ASPHALT OUTERWRAP
ASPHALT COATING
ROCK SHIELD

Agent for Gulf States Asphalt Co.

H & H GAS ODORIZERS
Built to your specifications

Manufactured by Tod Pazdral



GUILLOTINE SAWS
NATIONAL SAWS

Agent for E. H. Wachs Co.

MERCURY HYDRAULIC
PIPE PUSHERS

Tell 'Em
We'll Be There!

You can depend on Topaz sales engineers to be on the job--on time--working in cooperation with your engineering department. Topaz service includes furnishing all equipment on a lease, contract or purchase basis. Call Topaz day or night . . . we'll be there!

TOD PAZDRAL
PIPELINE SPECIALTIES
2525 South Boulevard • Houston 6, Texas
Day Phone JA 2-1403 • Night Phone MA 3-5680

ToPaz

of floating drydocks at the company's Morgan City, La. yard. He has been chief engineer since 1945.

Marcoux joined the company in 1923. During the war he was in charge of the financial and accounting department of the company's shipyard division. He was elected controller in 1946.

R. C. Gaynor

F. E. Backus

Sales Appointments Announced By Darling Valve & Manufacturing

Darling Valve & Manufacturing Company has announced the appointments of Foster E. Backus as Mid-West regional sales manager and Robert C. Gaynor as sales engineer.

Backus will have headquarters in Toledo and supervise sales activity in the 13-state area from western Pennsylvania to the Dakotas and south to Kentucky. Gaynor, also headquartering in the Toledo office, will concentrate his efforts in Michigan and parts of Indiana and Ohio.

Backus, who has 10 years of sales experience with Darling, moves to his new post from the territory now served by Gaynor as a sales engineer. Gaynor previously was employed by Continental Can Company.

Le Roi Division Assigns Permar To New Sales Manager Position

Don S. Permar has been named to the newly created position of assistant general sales manager for the Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis.

Don S. Permar

Permar has been field sales manager for Le Roi since September, 1954. Prior to that time, he was sales manager of stationary air compressors. Permar joined Westinghouse Air Brake Co. as a pneumatic engineer in 1945 and came to the Le Roi Division in the spring of 1954.

Persson to Head District Sales Office for A. O. Smith Corp.

A. C. Persson recently was made north central district sales manager of pressure vessels and heat exchangers for the A. O. Smith Corporation. Persson, a former sales engineer for the company's Process Equipment division, will continue to make his headquarters in Chicago.

Hendrickson Named Sales Manager For Minnesota Mining & Mfg.

Melvin A. Hendrickson has been promoted to sales manager for Pipe Protection Products, Electrical Products division

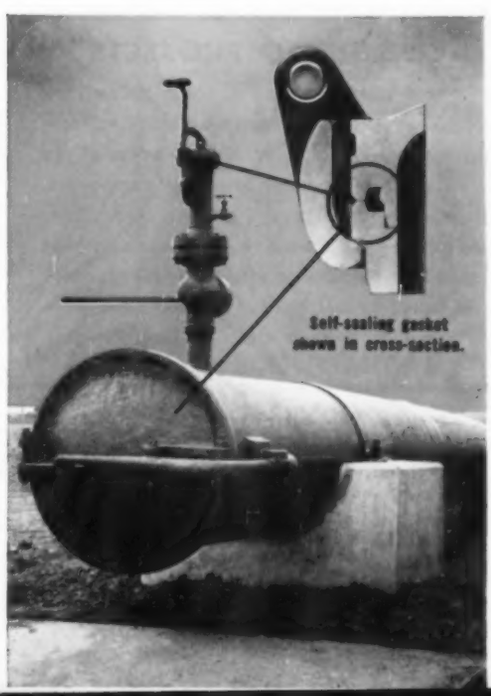
For more data on advertised products, use Readers' Service Cards, last page.

If you are a pipeliner

you'll appreciate this self-sealing gasket in UNIBOLT scraper trap and blowdown closures

Little things . . . like the gasket for a scraper trap or blowdown closure for example . . . can be a big headache. But not this one. It is the self-sealing gasket used in UNIBOLT pipeline couplings. The UNIBOLT design makes line pressure do the sealing. And this design practically encloses the gasket in steel so that when the closure is opened and closed the gasket is hardly disturbed. Made of oil- and gas-resistant Hycar nitrile rubber, this gasket will last indefinitely under normal conditions.

UNIBOLT scraper trap and blowdown closures are hinged for easy operation. Release only two bolts and the closure swings open and shut like a door. No heavy lifting. No time-consuming multi-bolt flanges. Write for complete information.



THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

of Minnesota Mining & Manufacturing Company.

Hendrickson, who joined the company in 1954, has been a sales representative for the Electrical Products division in the Schenectady, N. Y., area since 1954.

M. J. Crose Manufacturing Co. Expands Canadian Service

Crose-Curran Ltd., Canadian subsidiary of M. J. Crose Manufacturing Co., Tulsa, has announced the opening of a new branch office in Winnipeg, Man.

The new outlet will be managed by Hugh Trussell under the supervision of J. W. Brand, Crose-Curran Ltd. vice president headquartered at Edmonton, Alta.

In addition to its Canadian subsidiary, the Crose company has 14 foreign representatives in pipe line areas throughout the world.

Southern Pipe Coating Builds Pipe Processing Plant

Southern Pipe Coating Company has completed a $300,000 plant in Doraville, Ga., where high quality coating and wrapping will be applied to gas and gasoline transmission pipe.

J. C. Matthews

Sales offices are in Atlanta with J. C. (Chris) Matthews serving as sales manager. Matthews formerly was with the Barrett Division of Allied Chemical and Dye Corporation.

The 17-acre plant facilities are designed to process 12 miles of pipe a day and eventually will be on a 3-shift, 24-hour a day operating schedule.

Southern Pipe Coating's facilities include, in addition to the automatic handling equipment, a double "holiday" detection test for locating defects in coating or wrapping. The plant's large pipe storage area enables customers to store pipe before processing and have it shipped to job sites immediately after coating.

Southern Pipe Coating's plant was designed and equipped in cooperation with Crutcher-Rolfs-Cummings, Inc.

Shumate to Represent W-K-M In Dallas-Fort Worth District

Charles R. Shumate

Charles R. Shumate has been appointed sales representative for W-K-M gate valves in the Dallas-Fort Worth district for W-K-M Division of ACF Industries, Incorporated.

Shumate, who has been with W-K-M since 1951, was with the Engineering department and recently has been in charge of special projects as a sales engineer.

U. S. Steel Moves Long To Field Representative Job

Charles S. Long has been named U. S. Steel Oil Well Supply Division field representative at New Iberia, La. Mr. Long was employed by U. S. Steel in 1955 at New Iberia.

Allis-Chalmers Names Collett To Sales Manager Position

Wallace Collett was appointed product sales manager, Material Handling department, Tractor Group, Allis-Chalmers Manufacturing Co. Until now he was associated with the Tractor Group's sales training section in Milwaukee.

Wallace Collett

Collett entered the material handling field in 1946. He joined Allis-Chalmers in 1950 as a material handling engineer for the former Buda Company at Harvey, Ill. When that company was acquired by Allis-Chalmers in 1953, Collett continued as an engineer. He came to Milwaukee in 1956.

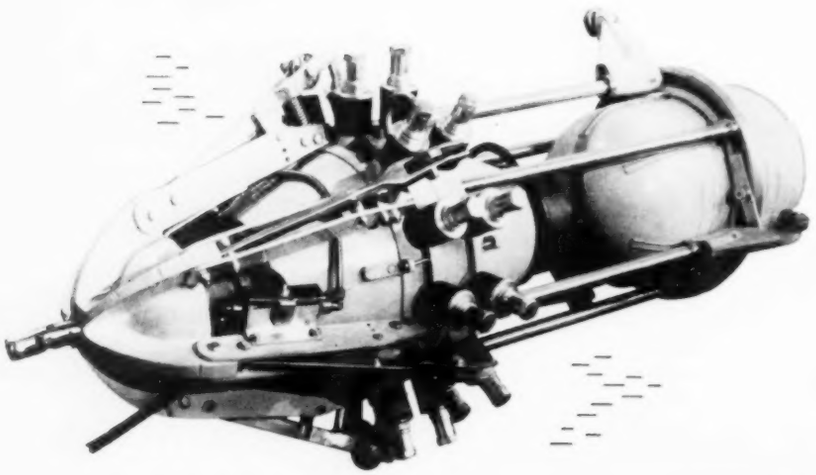
Hubert to Manage Division Of International Harvester

International Harvester Company has announced the appointment of Clarence A. Hubert, formerly manager of engineering of the Farm Tractor division, as general manager of the company's Construction Equipment division.

Hubert joined the Harvester organization in 1937 as an engine designer at Tractor Works, Chicago. He became engineer in charge of chassis design for farm

PERRAULT PNEUMATIC INSIDE LINE-UP CLAMP . . .

Reduces Pipe Line-Up Time Up To 50%



PROVED IN 27 COMPLETED PROJECTS

Has now been used by major pipeline contractors in all areas; coast-to-coast, and from Mexico into Canada on lines for some of the world's most important pipeline companies. Speeds jobs because air-operated studs bring pipe into true round without hi-lo hammering; makes good stringer beads quick and easy. Rental basis: For pipe sizes from 20" thru 36". More details? Call Perrault.

Everything For The PIPELINER

Coating and wrapping and cleaning and priming machines — line traveling or stationary: Glass Pipe Wrap, Asbestos Felt Wrap, Kraft Wrap, and Rock Shield. Tar-Heating Kettles, Burners, Patch Pots and Accessories. Pneumatic-Tired Lowering-In Cradles, Adjustable Pipe Cradles, Five-roller Cradles, Tongs, Hooks, Blocks, Belts, Slings, Line-up Clamps, Hand Tools, Supplies and Equipment of every sort.

PERRAULT EQUIPMENT COMPANY

1130 N. BOSTON — TULSA, OKLA. — TELEPHONE LUther 5-1103

tractors and crawler-type tractors in 1940. At the time of the formation of Harvester's Farm Tractor division in 1944, he was named chief engineer.

Hubert was named assistant manager of engineering of the Farm Tractor division in 1945 and manager of engineering for the division in 1946.

James G. Hudnall

Billy D. Cass

Beaird Adds Engineers In Compressor Division

Billy D. Cass and James G. Hudnall have been appointed sales engineer and service engineer respectively by J. B. Beaird Company, Inc., Shreveport, manufacturer of packaged compressor plants.

Cass, new sales engineer for packaged compressors and plant storage vessels, will cover the territory from Tulsa to Denver. He has been with the Monarch Heating Corporation in Tulsa for the past two years.

Hudnall, who has joined Beaird as compressor service engineer, will be based in Shreveport. He formerly was with Union Carbide & Carbon Chemicals in Texas City as chief operator in the Gas department for nearly eight years.

International Harvester Co. Lists Personnel Changes

International Harvester Company has announced a series of personnel changes among the company's top management.

Personnel changes included the retirement of Edward M. Ryan, vice president, foreign operations, after 46 years of service with the company. Theodore B. Hale, vice president, farm equipment sales, resigned after 45 years.

Mark V. Keeler, formerly vice president, Farm Tractor division, became vice president, Farm Equipment group. Former vice president of the Farm Implement division Eugene F. Schneider is now vice president of farm equipment product planning and will organize and head this new staff function.

Jack L. Camp succeeds Ryan as director of foreign operations. Charles D. Roice, formerly director of foreign operations, is now director of farm equipment product planning and will serve there with Schneider.

Crutcher-Rolfs-Cummings Distributes "Sooner Boomer"

Crutcher-Rolfs-Cummings, Inc., Houston pipe line equipment firm, has been authorized as exclusive pipe line distributor for the new "Sooner Boomer." The "Sooner Boomer," built in Oklahoma City, by Pneumatic Pipelayers, Inc., is a Ford Tractor with a side-boom and counter-weight mounted on it.

Graver Tank Celebrates Centennial Anniversary

Graver Tank and Manufacturing Company, Inc. is celebrating its 100th anniversary this year. The company has grown from an organization that employed only the two Graver brothers, who founded the firm, to the more than 4000 people employed in plants and divisions across the country at the present time.

The company was also the first industrial concern to move into the East Chicago-Gary-Hammond district which today has one of the more dense concentrations of heavy industry.

Raybestos-Manhattan Names 3 to Sales Engineering Posts

Three men have been named by Raybestos-Manhattan, Inc., to its sales engineering staff as specialists on adhesives, coatings and sealers.

They are David L. Seeber to northeastern U. S., with headquarters in Bridgeport; William E. Ford, Jr., to Ohio, western Pennsylvania and western New York, with headquarters in Cleveland; and Donald L. Davidson to Michigan and northwestern Ohio with headquarters in Detroit.

Shannon Gets New Sales Post In Washington and Oregon

Don R. Shannon has been appointed sales representative in Washington and Oregon for T. D. Williamson, Inc., Tulsa. Shannon has a total of six years experience in maintenance control and engineering at Northwest Airlines & Boeing Aircraft Co. He has completed the factory course on application, operation and maintenance of Williamson equipment.

Don R. Shannon

Other manufacturers represented by Shannon include RCS Tool Corporation and Bett-Marr Sales, Inc.

Allis-Chalmers Opens Australian Subsidiary

Allis-Chalmers Manufacturing Company has established a new wholly-owned subsidiary in Australia, the Allis Chalmers Australia Pty. Limited, and through it has purchased the assets of Thomas C. Pollard Pty. Limited, Newcastle.

The Pollard Company was owned by Tutt-Bryant, Ltd., Allis-Chalmers dealer in Australia. The plant will continue to make motor graders as it has done previously under license from Allis-Chalmers, and will expand production to other construction machinery.

C. A. Rechner will have supervision of the company's Australian operations.

U. S. Steel Names Austin To Research, Technology Post

Dr. James B. Austin has been appointed vice president—research and technology of U. S. Steel Corporation.

Austin was associated with the research laboratory of the corporation in Kearney, N. J., from 1928 until the laboratory was moved to U. S. Steel's Research Center in Monroeville, Pa., in 1956.

In 1946 he became director of research and moved to assistant vice president—research and technology in 1954. He became vice president—fundamental research in 1956.

Ray J. Fellows

F. Burrows Esty

Wisconsin Motor Corporation Announces Two Appointments

The Wisconsin Motor Corporation has announced the appointment of two new vice presidents. The two are F. Burrows Esty, chief engineer, and Ray J. Fellows, sales manager.

Esty has been with the engine firm since 1948, joining as assistant chief engineer and becoming chief engineer in 1955.

Fellows joined the company in 1938 as a salesman. In 1948 he was promoted to assistant sales manager and subsequently was appointed domestic sales manager, a post he has held since 1954 and which he continues to occupy as vice president.

Harnischfeger Corp. Names Jacobsen to Philadelphia Office

Harnischfeger Corporation has appointed Paul Jacobsen as excavator salesman for the Philadelphia office. Jacobsen will work out of the Washington, D. C., office handling sales of all Construction and Mining division products to both the commercial markets and Federal agencies.

International Harvester Has New Construction Division Head

Warren H. Thompson has been named general supervisor, Sales Development section, Construction Equipment division of the International Harvester Company.

Mr. Thompson has held the post of assistant general supervisor in Sales Development since 1954. Previously, he was a sales consultant in that department.

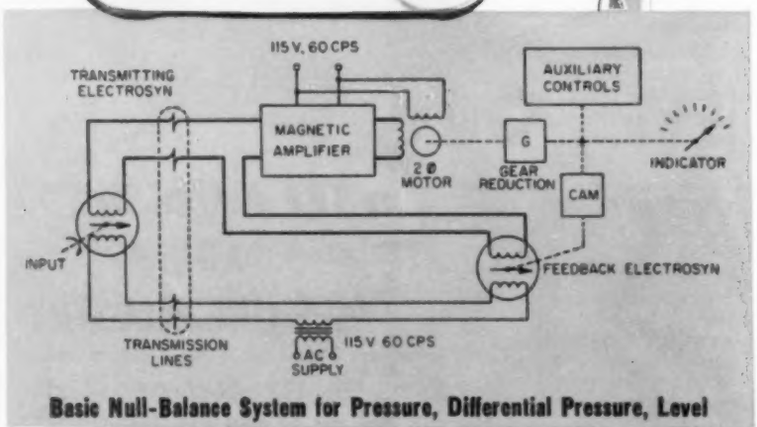
TRY A CLASSIFIED AD IN PIPE LINE INDUSTRY

Idle Equipment – Idle Dollars! Sell It Through a Classified Ad in Pipe Line Industry.

QUICK ECONOMICAL RESULTFUL

Need Engineers - Technical Personnel? A Classified Ad will get them for you.

ElectroSyn Pressure Transmitter Model 501



Basic Null-Balance System for Pressure, Differential Pressure, Level

Basic system consists of signal transmitter, magnetic servo amplifier, null-balance indicator. (No electron tubes or slide wires.)

In measuring pressure the Model 501 transmitter utilizes a twisted bourdon tube as the pressure sensing element. This tube converts the pressure into shaft rotation of the ElectroSyn, a rotary differential transformer. Output from the ElectroSyn is an a-c voltage exactly proportional to the measured pressure.

Copyright 1957 Detroit Controls Corp.

HIGHer reliability
LOWer maintenance

- *pressure*
- *differential pressure*
- *flow*
- *level*
- *temperature*

ELECTROSYN SYSTEM

ElectroSyn is a highly flexible, extremely rugged electro-magnetic system for a wide range of applications in the chemical processing, atomic power, natural gas and petroleum transmission fields. It is designed to measure, indicate, record (including analog to digital conversions), or control pressure, differential pressure, flow, liquid level, temperature.

Leading pipeline companies are using ElectroSyn systems for remote indication and data handling of pressures and flows because of system's reliability, flexibility and the fact that it can withstand a static overload of 300% of rated pressure for a 1% zero shift. For complete information write for Technical Bulletin B257.

NORWOOD CONTROLS
UNIT OF DETROIT CONTROLS CORPORATION
931 Washington Street, Norwood, Mass.

NORWOOD CONTROLS

What's New in Equipment

for the Pipe Line Industry

Shovel Crane

A new type of construction tool, fully convertible to shovel, crane, clamshell, drag and hoe, has been introduced by the Thew Shovel Company. Model SP-107 is a self-propelled machine mounted on a short-coupled, square (96 inches by 96 inches) rubber-tire carrier with four-wheel drive and requires no outriggers to develop a seven-ton lifting capacity in all positions of turntable swing.

Four-wheel drive is provided on the SP-107 along with hydraulic power steering on the wheels of one axle. Optional equipment provides for hydraulic power steering of all four wheels.

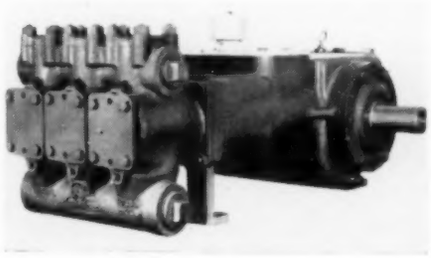
The power-take-off on the turntable is through an automatic transmission and torque converter.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Plunger Pump

A new P-300 Triplex Power Plunger Pump model has been announced by Frank Wheatley Pump & Valve Manufacturer. The most notable new design features are an offset crankshaft for longer bearing life, small discharge valves for reduction of hammer, large suction valves for positive filling, deep stuffing boxes for force-feed lubrication and long packing life, five plunger sizes and cartridge-type cylinder head stuffing boxes for easy access and maintenance. The pump is capable of pressures up to 3000 pounds per square inch and speeds up to 500 revolutions per minute. This extended range makes the P-300 applicable for installations ordinarily requiring a much larger pump.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.



Ladder-Type Ditcher

Gar Wood Industries Inc. has equipped its Model 160 ladder-type ditcher with new hydraulic controls. The ditcher is now equipped with a hydraulic boom hoist for positive positioning of the boom. The boom is raised, lowered and held by an independent, package-type hydraulic control system. Double-acting hydraulic cylinders provide full crowd for the boom. The 160 digs to a depth of 16 feet with widths from 18 inches to 48 inches.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Floating Roof Seal

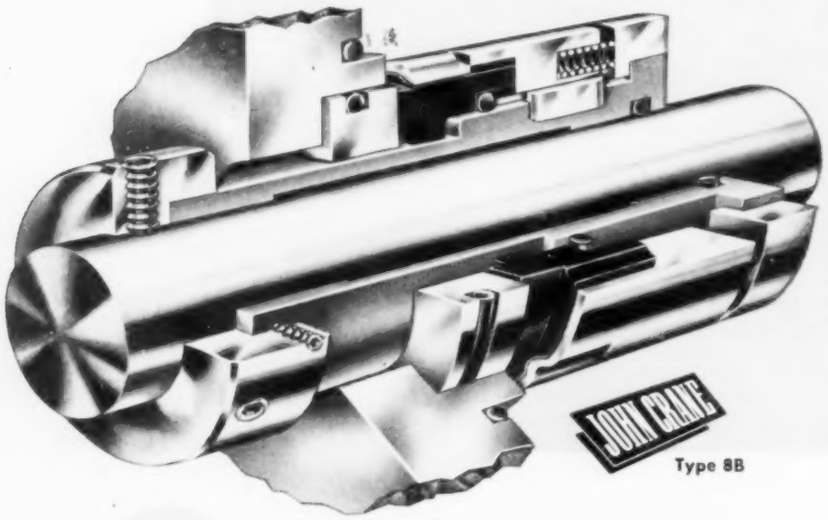
Nooter Corporation has been granted patents on a new, two-point suspension seal hanger which provides ease of installation and better radial alignment. This seal exerts a uniform outward pressure over the entire height of the shoe, affording better sealing action and reducing the possibility of abrasion at any one point. Another feature is the placement of all of the operating mechanism beneath the roof thus leaving the roof deck clear.

The Nooter seal is adaptable to the double-deck, pontoon and pan-type roofs as well as to any existing type of floating roof. It also can be installed, in a modified shoe design, in existing riveted tanks.

Size is no limitation in the design and construction of the floating roof tanks. The standard shoe material is galvanized steel and the standard shoe thickness is 14 gage. This can be furnished by Nooter in as heavy a thickness as 10 gage.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

THIS IS THE SEAL USED IN 75% OF ALL RECENT PIPE LINE PUMP INSTALLATIONS



Type 8B

These Important Facts Tell Why

Reports from the field reveal that after 2½ years of continuous operation "John Crane" Type 8B Seals are still in perfect operating condition. This adds up to over 20,000 hours without shutdown!

Man-hours are being saved. The 8B is quickly installed and adjusted simply by sliding the entire unit along the shaft into position. The top casing need not be removed.

High pressure problems are eliminated. "John Crane's" exclusive hydraulically balanced construction permits handling of pressures up to 1200 psi.

The 8B comes in a full range of sizes to meet individual specifications and can be engineered to practically any on-the-job requirement.

Be sure you get "John Crane" 8B Seal performance. **Contact Crane Packing Co., 6434 Oakton Street, Morton Grove, Illinois (Chicago Suburb).**

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

CRANE PACKING COMPANY

Triple Tamper

A triple tamper, the OT11, has a built-in line oiler and a handle grip throttle valve which assures a positive oil feed and increasing ease of operation. Manufactured by the Le Roi Division of Westinghouse Air Brake Co., the tamper's handle grip throttle incorporates a safety snap action which shuts-off the air supply when the lever is released and increases operator safety. A plug type throttle is available as optional equipment.

The tamper's line oiler is of non-splurging design and has an adjustable oil regulator. Operator safety is increased with the long handle bars. The weight of the tamper, 114 pounds, is distributed to utilize the power stroke of the tampers and to make handling easy. The three tamper butts cover a 70-square inch area and compact the same amount of backfill as five single tampers. All major working parts are steel drop forged.

(This item supplements Le Roi Division, Westinghouse Air Brake Co. data on pages 2941-2948 of the Composite Catalog, 21st Edition).

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

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Chemical Herbicide

A new granular chemical herbicide giving full season control of most annual and perennial grasses and broad leafed weeds in non-crop areas has been developed by General Chemical Division, Allied Chemical & Dye Corporation. The new product is designed for dry application with simple, inexpensive equipment and is marketed under the trade name of Urox Weed Killer.

Urox Weed Killer is recommended for use in clearing vegetation from non-crop areas such as highway rights-of-way, tank farms, etc. Because the product will not add to the flammability of weeds, it can be used safely around oil, gas and similar installations.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

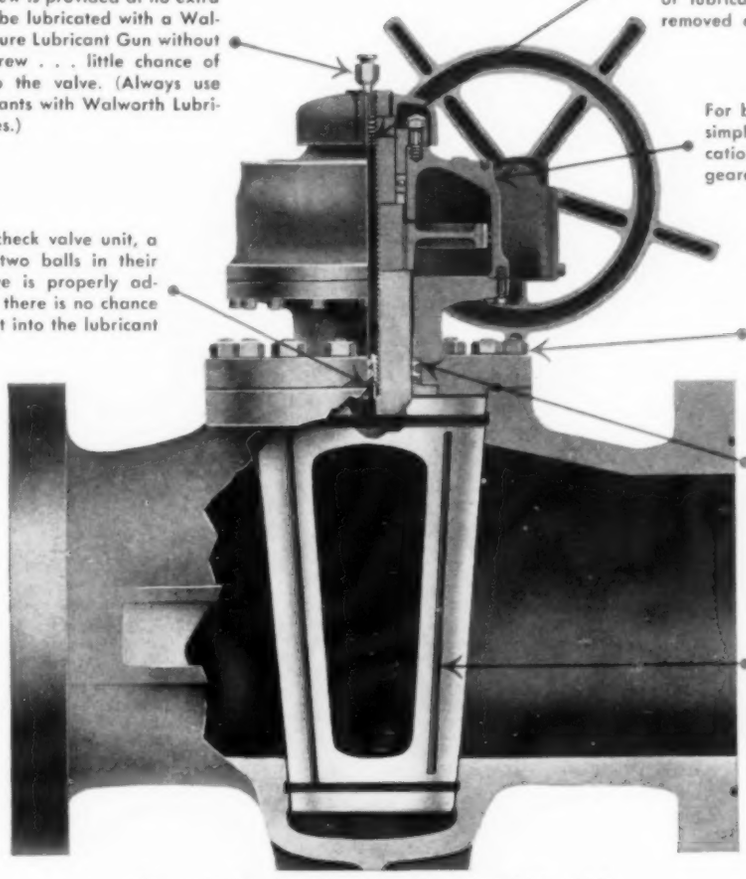
Let's get technical about WALWORTH LUBRICATED PLUG VALVES for pipeline service

Combination button-head lubricant fitting and lubricant screw is provided at no extra cost. Valves can be lubricated with a Walworth High Pressure Lubricant Gun without removing the screw . . . little chance of grit getting into the valve. (Always use Walworth Lubricants with Walworth Lubricated Plug Valves.)

An added safety feature in the form of a groove cut part way up side of the lubricant-fitting screw allows the operator to observe any tendency of lubricant to blow out *before* the screw is removed entirely.

For buried pipelines — yoke design permits simple attachment of handwheel and lubrication extensions without modifying the gearcase.

In the stainless steel check valve unit, a transverse pin holds two balls in their seats. When the valve is properly adjusted and lubricated, there is no chance for line pressure to get into the lubricant system.



Standard bolt threads, rather than fine threads, mean easy replacement of nuts and bolts from local stocks.

Two overlapping Teflon packing rings form an effective seal against possible leakage without "grabbing" the plug shank. Low breakout torque . . . plug turns easier. Packing serves only as a seal and is not used to hold the plug in its seat.

Lubricant grooves completely frame the port openings and encircle the plug at the top and bottom assuring a tight seal against leaks. Bottom circumferential groove is separate from, but connected with, the lubricant well.

Other Walworth Lubricated Plug Valves include Single Gland and Regular Gland types. Sizes to 30 inches. Pressures to 5000 psi. and for vacuum service.

Cutaway of a 24-inch Walworth Lubricated Plug Valve

Without exception, a Walworth Ball Bearing Lubricated Plug Valve is easier to operate and maintain than any other type of rotary-action, sealed valve available today for pipeline service. Design features pointed out here show just a few advantages of Walworth Ball Bearing Lubricated Plug Valves.

Many pipeline companies throughout the world use Walworth valves for handling gas, crude, and finished products. Investigate the line of Walworth valves for your own needs. See your Walworth Distributor, or write for literature: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

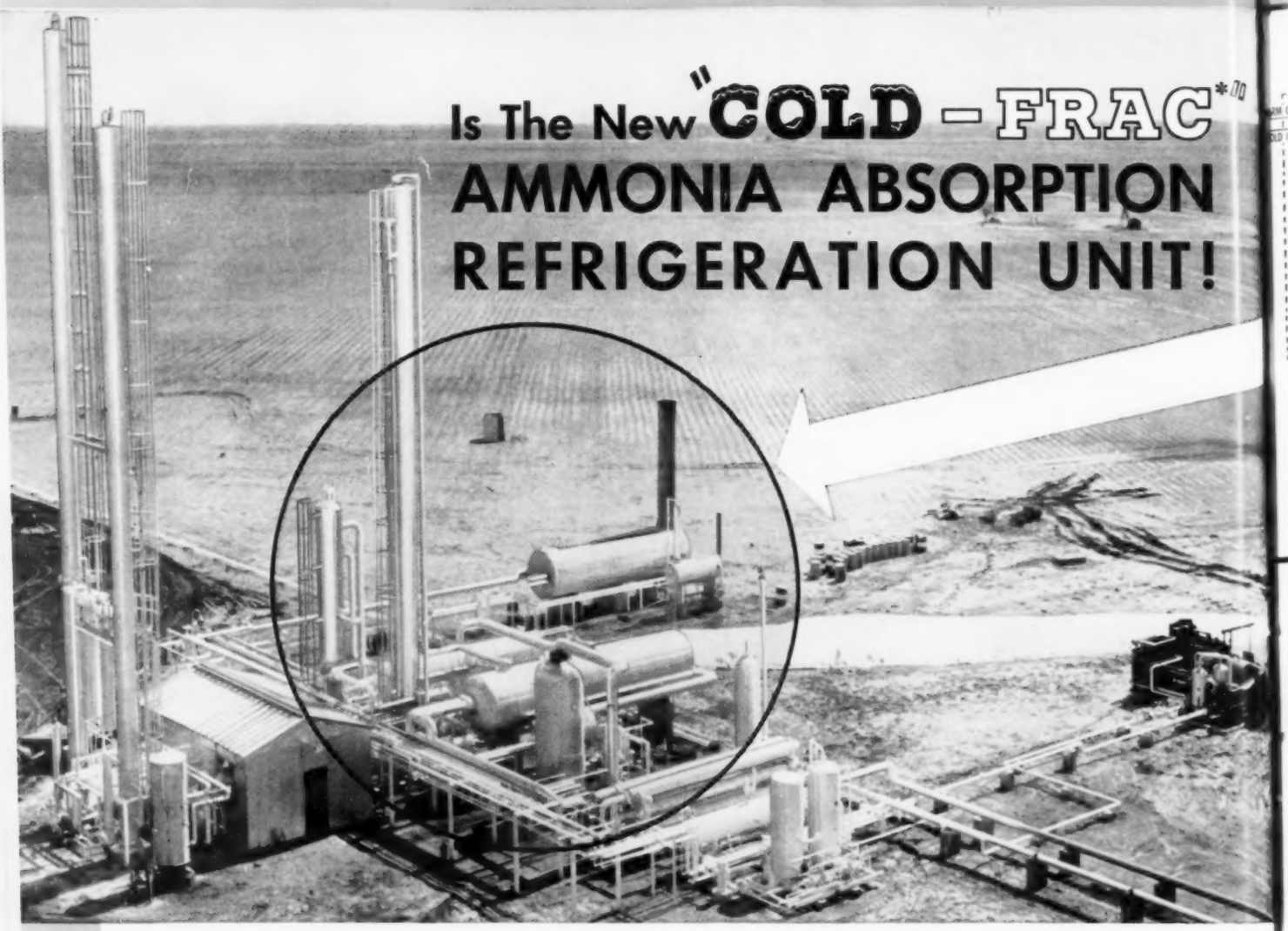
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION GROVE VALVE & REGULATOR CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. M & H VALVE & FITTINGS CO. WALWORTH COMPANY OF CANADA, LTD.

The "Heart" Of This BS&B



Is The New "COLD-FRAC"* AMMONIA ABSORPTION REFRIGERATION UNIT!

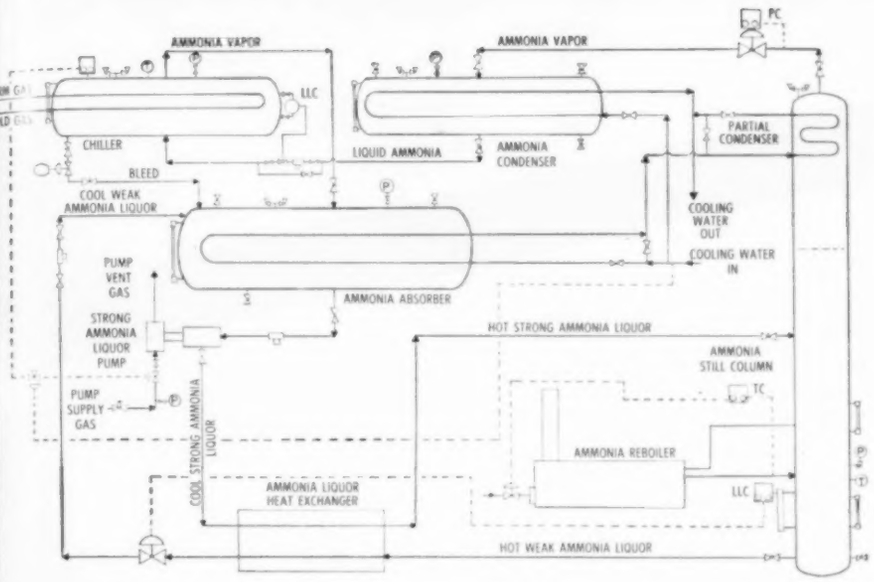
Ammonia Absorption Refrigeration Yields Low Dew Point Gas And Salable Liquid Hydrocarbons

Early this year, Excelsior Oil Corp. (a subsidiary of Kansas-Nebraska Natural Gas Company, Inc.) put a new gas gathering plant on stream at Tyrone, Oklahoma. This plant, employing the new BS&B "COLD-FRAC" AMMONIA ABSORPTION REFRIGERATION Unit, is located on a major gas transmission line and was entirely designed, manufactured and constructed by BS&B on a "turnkey" basis. Here, in brief, are the important facts:

EFFICIENCY
OVER 60 YEARS
BS&B
RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

Your BS&B Man will be glad to give you detailed information on the new BS&B "COLD-FRAC" Ammonia Absorption Refrigeration Unit. Or, you may write to...

B "Turnkey" Gasoline Plant...



THE OBJECTIVES:

1. To Achieve Maximum Dehydration Of The Gas Stream.
2. To Lower Hydrocarbon Dew Point To 0° F.
3. To Economically Extract Maximum Amount Of Salable Liquid Hydrocarbons Without Lowering Gas BTU Value Below Acceptable Limits.

The Company asked BS&B Engineers to analyze the objectives, and to recommend a suitable type plant.

THE RESULTS:

The low temperature plant was built "turnkey" by BS&B, incorporating Ammonia Absorption Refrigeration. This resulted in low water dew point, positive hydrocarbon dew point and the recovery of salable liquid hydrocarbons.

Ten Advantages Offered By BS&B "COLD-FRAC" Ammonia Absorption Refrigeration Units:

1. **Entirely Self-Operating.** Automatically Adjusts to Load Changes.
2. **Low Initial Cost.** Unit Is Entirely Skid-Mounted Except Ammonia Reboiler. Outside Construction — No Buildings Required.
3. **Low Cost Maintenance.** Liquid Pump Is the Only Moving Part.
4. **Operating Costs Vary** in Direct Proportion to the Load.
5. **Lower Operating Temperatures** Do Not Materially Decrease Capacity.
6. **Completely Closed System.**
7. **Chiller "Slop Over" of Liquid Refrigerant Causes No Problem.** (There is no compressor to cause worry about liquids in the suction.)
8. **Oil Lubrication Eliminated.** No Oil-Refrigerant Problem.
9. **Vibration Free.** No High Speed Reciprocating Machinery to Mount.
10. **Experts Are Not Required** to Operate and Maintain the Unit.

OTHER APPLICATIONS

BS&B Ammonia Absorption Refrigeration Units are applicable to any process that requires temperatures below ordinary atmospheric level, including all steps in the complete production cycle from the lease through the central plant to the refinery.

These units are constructed for heavy duty, continuous 24 hour-per-day, 365 day-per-year operation. Available in eleven standard sizes—with nominal capacities of up to 200 tons—these units have been designed to provide trouble-free, completely automatic operation under all conditions with minimum maintenance expense. Units larger than 200 tons in size offered on request.

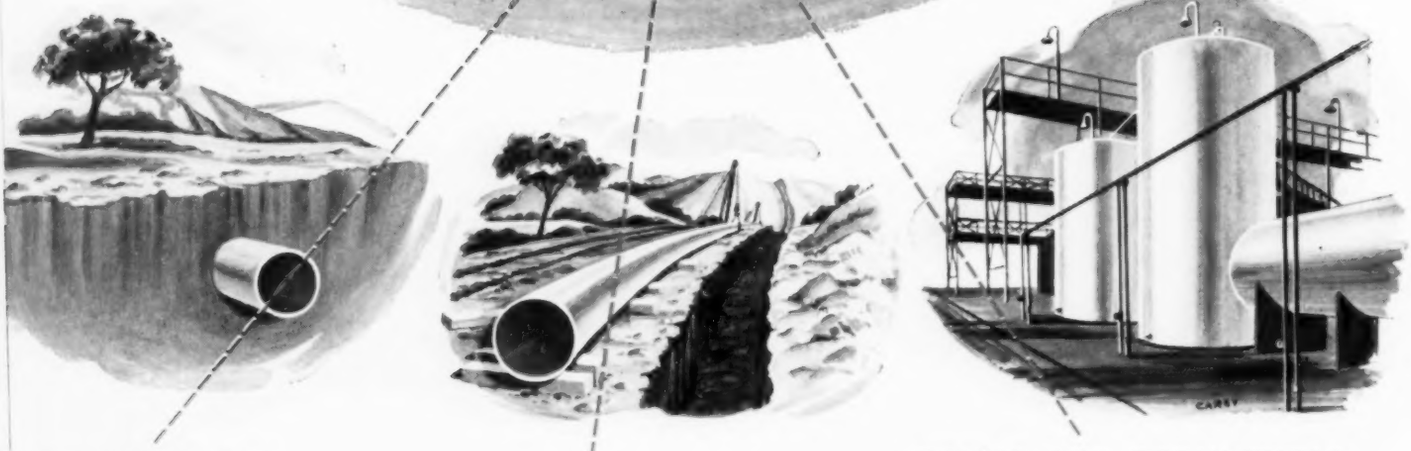
* "COLD-FRAC" is a trade-mark of Black, Sivalls & Bryson, Inc.

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-EP6

P. O. Box 1714 Oklahoma City, Okla.

Whatever your coating problem



PIPE IN GROUND

NEW CONSTRUCTION

TANKS AND STRUCTURES

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Proven systems for external or internal protection of...

- Dehydrated gas lines
- Crude and petroleum product lines
- Salt water lines
- Fresh water lines
- Oil well tubing and casing
- Repressuring units

In every phase of the oil and gas industry, Copon Coatings are doing a job reducing corrosion losses. But in many instances, they are accomplishing even more.

Gas transmission companies report smooth, durable Copon Internal Pipe Coatings provide extra dividends of increased thru-put, cleaner delivery and reduced pigging costs. Installations at pumping plants and refineries prove Copon External Tank Coatings stay dazzling white despite exposure to severe atmospheric conditions, chemical fumes and spillage.

Copon Coatings, and systems for coating underground pipe lines in place or individual joints for new construction, have been developed in close cooperation with leading corrosion engineers. A complete technical service is available. Write today for help with your specific problem.

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OR CORROSION CONTROL

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P. O. Box 8010, Pittsburgh 16, Pa.

Pipe Rotator

Reed Equipment Division of The Webb Corporation has introduced the M-15 portable pipe rotators. These units, consisting of one variable speed powered and one idler rotator, are used to rotate pipe and cylindrical shapes for flame cutting and welding operations.

Capacity of one power and one idler unit is 1500 pounds total load. More than one idler can be used where long joints of pipe are to be welded or where load capacity needs to be increased. All wheels on both power and idler units are rubber tired.

Wheel centers on both units are fixed, requiring no adjustment on pipe sizes from 2 to 24 inches. Also available is a unit having adjusting spacing for work up to eight feet in diameter.

The units can be used as portable rotators for field use or they can be used in shops equipped with 110 volt A.C. current.

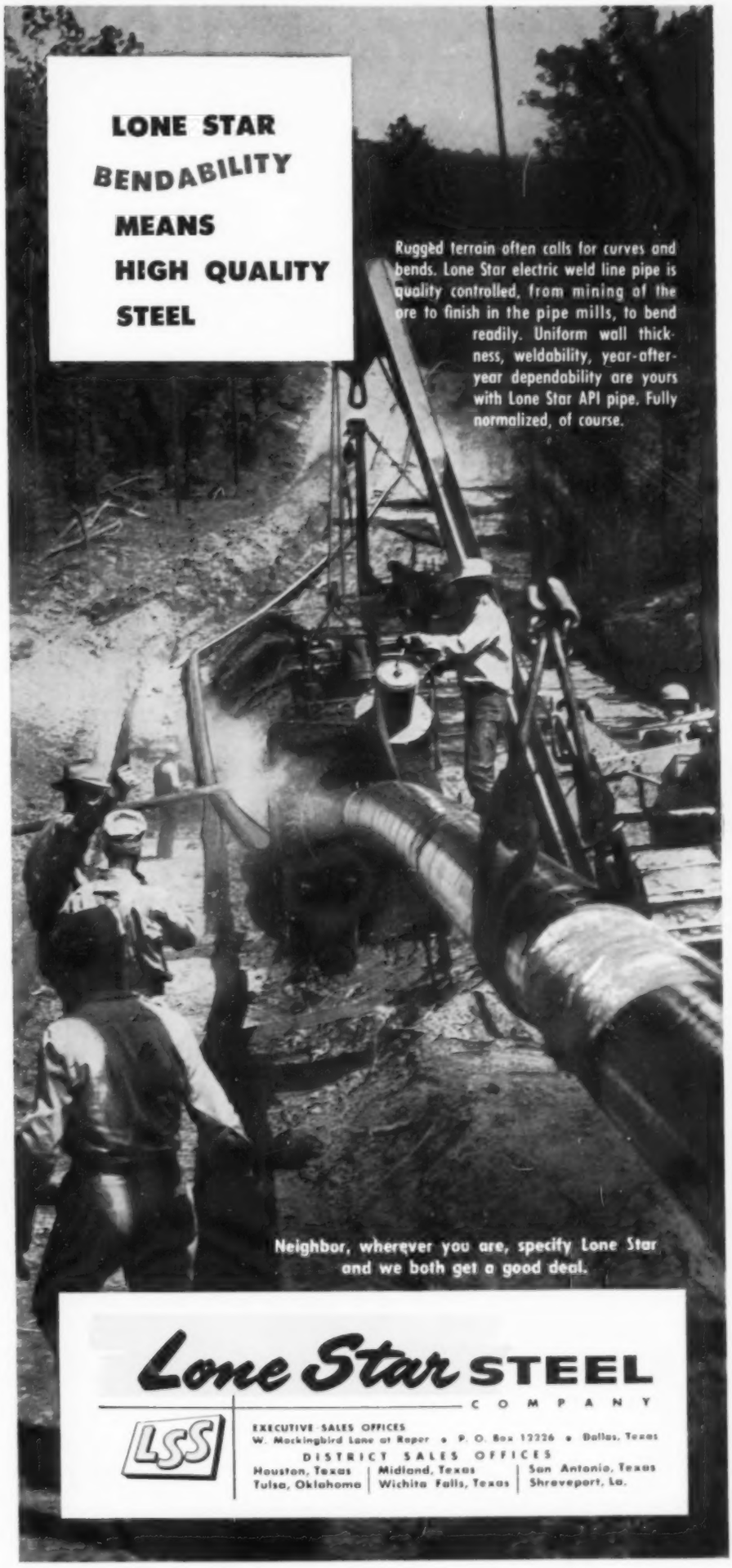
For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Aluminum Grating

An aluminum grating has been announced by the Klemp Metal Grating Corporation. The RR type aluminum grating was designed to retain the combined advantages of a rectangular opening and riveted gratings. This grating remains structurally rigid regardless of cutouts located in any part of the panel.

The grating has been laboratory and field-tested over a period of five years to meet exact load conditions. There is a 79 percent clear opening with the striking rectangular design.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.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BENDABILITY
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HIGH QUALITY
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Rugged terrain often calls for curves and bends. Lone Star electric weld line pipe is quality controlled, from mining of the ore to finish in the pipe mills, to bend readily. Uniform wall thickness, weldability, year-after-year dependability are yours with Lone Star API pipe. Fully normalized, of course.
Neighbor, wherever you are, specify Lone Star and we both get a good deal.
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WORKING ON THE HEELS OF THE LOWER-IN CREW a one-man-operated Cleveland 190 helped to keep this United Gas pipeline job moving along, leaving no open trench at the end of any day's work. A report from Fowler-Tatom Pipeline Contractors states, "The Cleveland 190 backfilled trench almost as fast as a man can walk." Where trenches were water-filled the 190 tied down pipe then doubled back to complete the fill and finished it off with a neat clean-up job. Much of the 16-mile line from the Chocolate Bayou field to the main line near Webster, Texas, cuts through rice-growing farmlands, so the 190 had to pull down big heavy spoil banks of wet sticky gumbo much of the way.

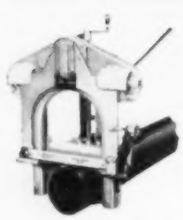
THE CLEVELAND TRENCHER COMPANY, 20100 St. Clair Avenue, Cleveland 17, Ohio

(Advertisement)

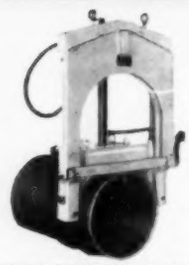
WACHS *Portable*

POWER AND MANUAL PIPE CUTTERS

2" TO 72" CAPACITY

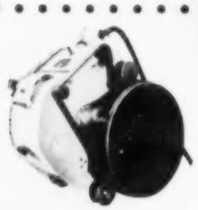


WACHS GUILLOTINE SAW
2" to 8" Capacity
Electric or Air Drive

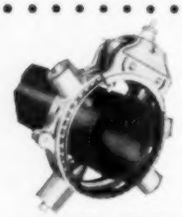


"BIG" GUILLOTINE SAW
10" to 16" Capacity

WACHS CHICAGO



WACHS NATIONAL SAW
"The milling machine on wheels"
Cuts 10" to 72" Pipe



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RATCHET CUTTER
"Lathe Type Cuts"
5 sizes—2½" to 24" Capacity

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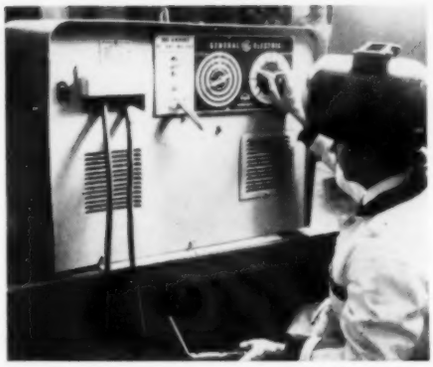


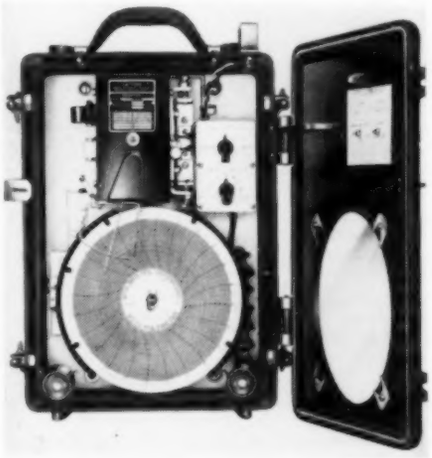
Motor-Generator Welders

A new line of motor-generator welders, featuring pre-lubricated, sealed bearings, controlled current peaks, and space-saving design, has been announced by General Electric's Welding department. An improved magnetic starter with fast response, bi-metallic thermal overload relays prevents motor burn-out in the event of motor overload. The relays will kick-out in less than ten seconds in stalled single phase, and in less than eight seconds if the rotor is locked in normal three-phase position.

The welders produce the same high recovery voltages and controlled current peaks with pop-out-free arcs as engine-driven units. Built with push-button controls, the new units include generator, driving motor and accompanying controls encased in a weather-resistant case.

(This item supplements General Electric Co., Apparatus Sales Division data on pages 1957-1976 of the Composite Catalog, 21st Edition.)

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



Recorder

The Bristol Company has introduced a new, self-contained, portable millivoltmeter recorder for survey work. The instrument incorporates a variety of ranges and can be used to study conditions encountered in survey work which involves the measurement of voltage and current.

The millivoltmeter recorders are offered with movement sensitivities of either 2000 or 10,000 ohms per volt. Each instrument is equipped to measure over eight ranges and records on an eight-inch diameter, carbon-coated chart. The sensitive recording instrument can be used for long term continuous records.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

BRANCH
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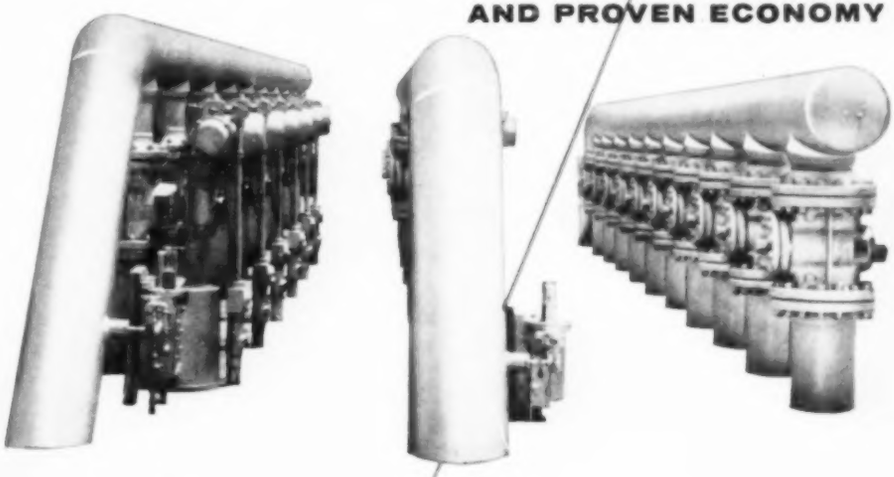
WELDOLETS

FOR ASSURED STRENGTH
AND PROVEN ECONOMY



WELDOLETS

THREDOLETS

SOCKOLETS

Are you effecting this economy for your company? Neat and uniform appearance is evident in code constructed weldolet headers in this crude oil pipeline terminal. The money saved is in the bank and does not appear in this picture. If you are not using the weldolet method of cutting piping costs, write today for information.

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PIPE LINE HALF SOLES

SLEEVES

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CONCRETE RIVER WEIGHTS

Edwards Concrete River Weights installed on another major pipeline. Where volume permits, Allan Edwards, Inc., can construct river weights on the job-site, saving time and money. Other fine Edwards products include split welding sleeves, half soles and concrete marker posts.

PIPE LINE, REFINERY & GASOLINE PLANT EQUIPMENT ENGINEERS

Allan Edwards, Inc.

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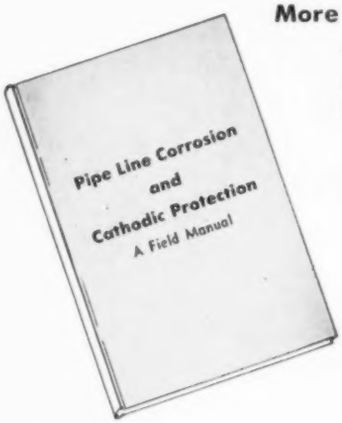
Phones: DI 3-7184 – DI 3-8390



More comments on this new Handbook:

"... a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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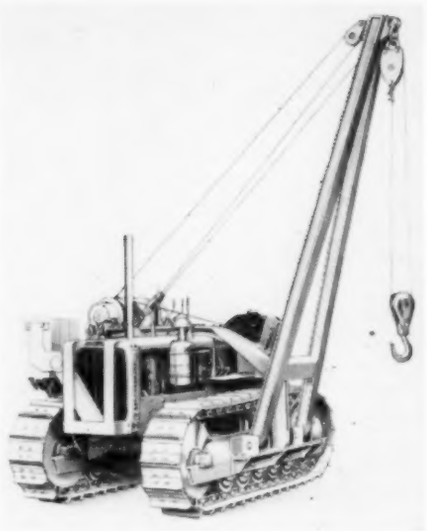


Pipelayer

Now available is a Caterpillar D4 Tractor arrangement which incorporates a newly-announced No. 4 Hydraulic Pipelayer. The pipelayer is designed for use on smaller diameter pipe lines and is manufactured by Midwestern Manufacturing Company, Tulsa, Okla.

The No. 4 Hydraulic Pipelayer has a rated lifting capacity of 17,500 pounds at four-foot overhang and has a boom length of 13 feet. When attached, the No. 4 Hydraulic Pipelayer provides a tractor clearance of 13½ inches. Hydraulically operated counterweights are furnished as standard equipment.

The pipelayer is especially suited for use by contractors specializing in small pipe. It can also be used for handling such miscellaneous items as concrete drain pipe and can serve as a mobile crane with relatively large capacity.

Simplified operation, precise positioning and maneuvering of heavy loads is made possible by a closed hydraulic system controlling the sideboom. Throttling type hydraulic valves assure positive and rapid response of the sideboom. The unit can also do an efficient job of backfilling when it is equipped with an angle filler which is also available and which operates from the same hydraulic system as the pipelayer.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Fittings

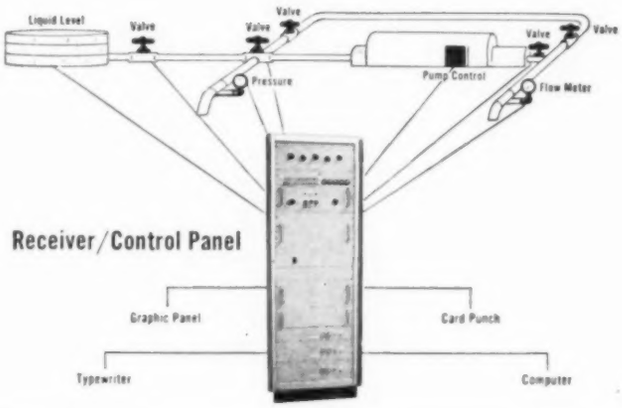
W-S Fittings Division's Forged Carbon Steel Fittings are now being manufactured with a blue coating that protects them from corrosion in storage and in service. The thin coating is applied to the fittings after machining and cleaning so that threads and sockets as well as external surfaces are protected.

The primary purpose of the coating is to prevent unsightly and sometimes damaging rust which generally occurs during storage or field-handling of unprotected fittings. The coating also provides an excellent base for paint.

Carbon steel fittings available with the blue coating include sizes ⅛-inch to 4 inches in 2000, 3000 and 6000 pound screw-end type and schedule 40, 80, 160 and XX socket-welding type.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

Automatic Monitoring and Control of ANY Remote Pipeline Operation



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Bendix-Pacific ELECTRO-SPAN

THE LOW COST DIGITAL SYSTEM

Electro-Span Systems are accurate, reliable digital data transmission systems for pipeline telemetering and supervisory control.

Any number of remote pump stations or functions can be controlled from one or more control locations with these Bendix engineered systems.

The functions of control, indication, data-logging, and monitoring can be provided singly or in combination, providing the most accurate, efficient and inexpensive use of standard communication links.

Write for the new brochure which fully describes these pipeline supervisory control and data-logging systems. Please request Bulletin ES-12.

VERSATILE TANK GAUGING SYSTEMS

Any number of tanks can be measured and controlled by the Bendix digital pulse-code system. The receiving equipment can indicate tank liquid level in feet, inches and eighths as well as temperature by tank number and can scan several tank farms automatically. Write for Bulletin ES-5A for full information.

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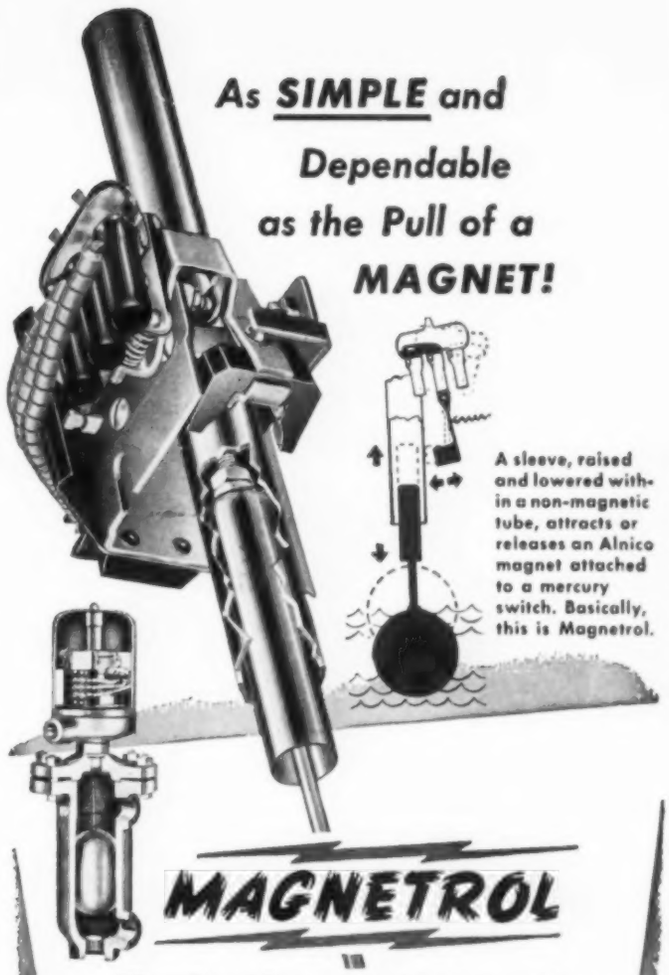
As SIMPLE and Dependable as the Pull of a MAGNET!



A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol.

MAGNETROL

The Simplest, Most Versatile LIQUID LEVEL CONTROL Ever Devised!

Linked to liquid level by infallible magnetic force, Magnetrol is free from the limitations inherent in mechanical or electrical controls. With the actuating magnet rated at 98% of initial strength after 30 years, Magnetrol has *infinite operating life*, with practically no maintenance at all. There are no wearing parts to get out of order.

What's more, Magnetrol's simple operating principle permits easy, economical modification of standard units to meet *any* pressure, temperature or corrosion requirements. That's why there's practically no limit to Magnetrol's use. It's also why "specials" are likely to be standard with us. Magnetrol units control level changes from .0025-in. to 150-ft. —with single or multi-stage switching.

MAGNETROL, Inc.

● *SEND COUPON FOR DETAILS*

MAGNETROL, Inc. 2128 S. Marshall Blvd., Chicago 23, Illinois
Please send me catalog data and full information on Magnetrol Liquid Level Controls.

Name _____
Company _____
Address _____ Zone _____ State _____

For more data on advertised products, use Readers' Service Cards, last page.

the WRENCH we made for YOU

Lowell #50-A Reversible Ratchet Wrench

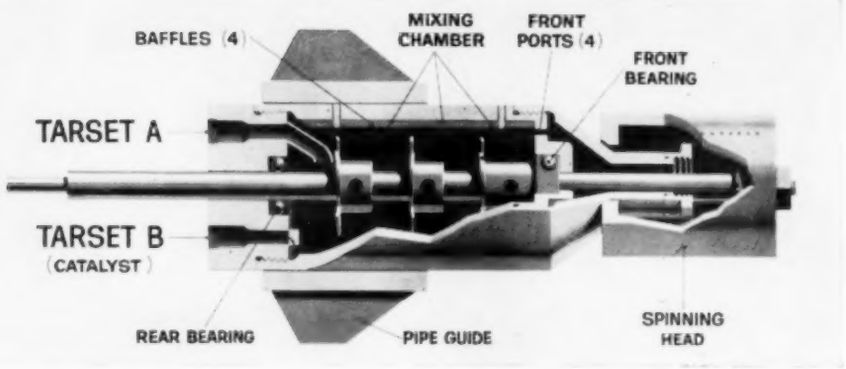
for speedy installation of pipe line mechanical joints.

Reversible ratchet allows fastest possible tightening of 5/8" hex bolts —special 8" handle assures correct torque, as suggested in American Standard Specifications.

Ask your local industrial distributor for the #50-A Wrench by *Lowell* – makers of industrial wrenches for more than 85 years

or write direct to

LOWELL WRENCH CO.
WORCESTER 8, MASS.

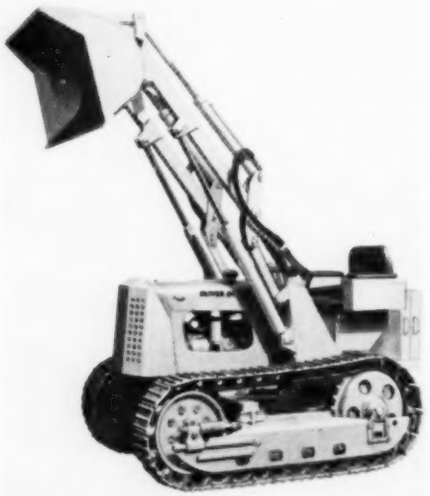


Coating Applicator

A new machine for applying Tarset, a coal tar-epoxy resin coating, to pipe interiors has been developed by the Protective Coatings Division of Pittsburgh Coke & Chemical Company. The applicator is capable of laying a smooth film of coating on the interior of 20-foot lengths of 3, 4 and 6-inch pipe.

Two novel features are incorporated in the construction of the applicator. First, the tar-epoxy blend and its catalyst are fed separately into the applicator in carefully controlled proportions where high speed mixers blend the two components. Second, the mixed material is expelled from the mixing chamber under positive pressure into a spinning cylinder which centrifugally casts the coating on the interior surfaces of the pipe.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.



Loading Machine

The Oliver Corporation has developed a digging and loading machine with backhoe attachment which is labeled the Oliver OC-46. Built as a tractor-loader in one basic unit with simplified trencher mounting, it features a 22 d.b.h.p. engine with four-speed transmission.

The Oliver OC-46 is built with an improved low-silhouette profile which was designed to reduce pedestal height and permit better operator vision as well as greater loader stability. The five-eighths-yard bucket features increased roll-back and dump angle in addition to deeper penetration.

The crawler assembly has four lower track wheels and full-length side panels to protect against damaging rocks. Track gage is 46 inches. Two-point hitch design allows hookup or removal of the trencher in 90 seconds.

Fully hydraulic, the Jet-Trencher digs to 11 feet, loads to 8 feet, 10 inches and has a full 180 degrees boom swing.
For more data, circle **No. E14** on Readers' Service Card, last page this issue.

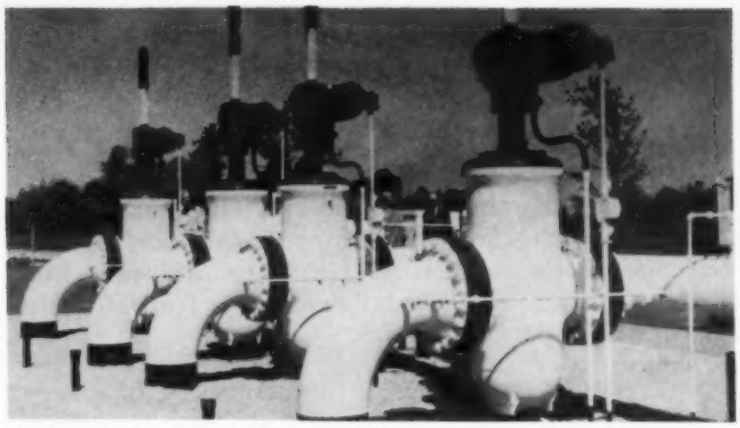
Sump Pump

Schramm, Inc. has introduced a portable sump pump with the pump body, impeller and strainer made of bronze to resist corrosion and to insure spark-free operation. Heavy duty thrust and radial bearings support the two-part, non-clogging impeller which is mounted on a stainless steel shaft. Bearings are double-sealed for protection.

The pump requires no priming. Measuring a little over 19 inches high, it can be passed through a hole as small as 9 by 11 inches. Any liquid over 1⅜ inches deep can be picked up and solids over ¾ inches are blocked out by the integral bronze strainer.

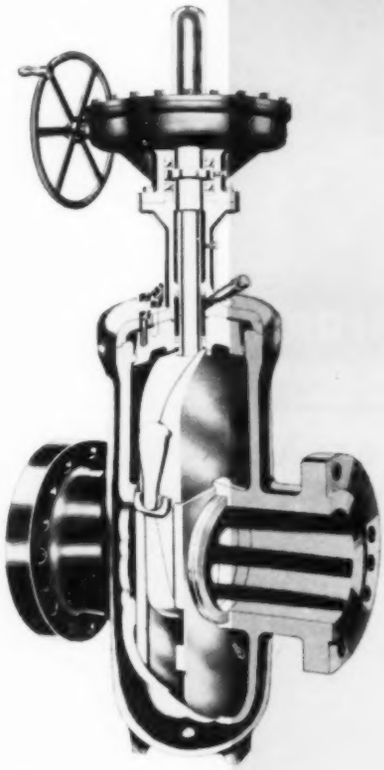
Pump speeds vary between 3200 and 3600 revolutions per minute depending upon the head against which it is pumping and the supplied air pressure. Excessive speed is prevented by a built-in governor.

(This item supplements Schramm, Inc. data on pages 4414-4415 of the Composite Catalog, 21st Edition.)
For more data, circle **No. E15** on Readers' Service Card, last page this issue.



W-K-M *Valves on gas line manifold.*

W-K-M THROUGH CONDUIT VALVES MEAN PIPELINE OPERATING ECONOMY



5705

The through-conduit of W-K-M Valves means "expressway" flow on the pipeline. There's no turbulence—no more pressure loss through a full-opening W-K-M Valve than through the same length, same size pipe—no additional power required to move gas or liquid through the line—that's economy!

W-K-M Valves have the right variable ratio of port opening to gate travel to close smoothly and rapidly without setting up dangerous line surges. Scrapers pass through the valve as easily as they go down the line—there's no danger of sticking a "pig" in a W-K-M Valve.

Here's more economy with W-K-M Valves—seats are protected against damage in either open or closed position; Leverlock* assures free movement of gate against any pressure; and repairs can be made without removing the valve from the line, and in many instances while valve is under pressure.

Specify W-K-M Through-Conduit Gate Valves for years of service with minimum maintenance.

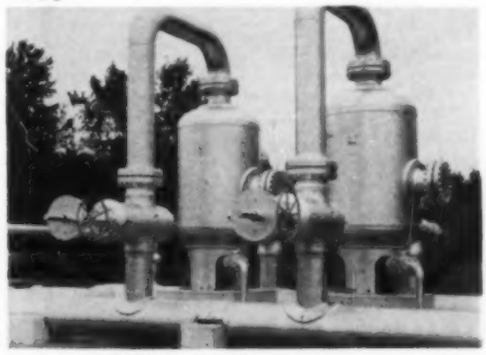
W-K-M ASA Through-Conduit Gate Valves are available in sizes 2" through 30"—ASA 300 lbs. to ASA 900 lbs. Valves up to 12" available through supply stores.

*Trademark of W-K-M a Division of OCF Industries, Inc.

W-K-M
DIVISION OF OCF INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

MANUFACTURERS OF W-K-M GATE VALVES OCF LUBRICATED PLUG VALVES KEY-KAST ALLOY STEEL PIPING FITTINGS KEY RETURN BENDS AND FITTINGS



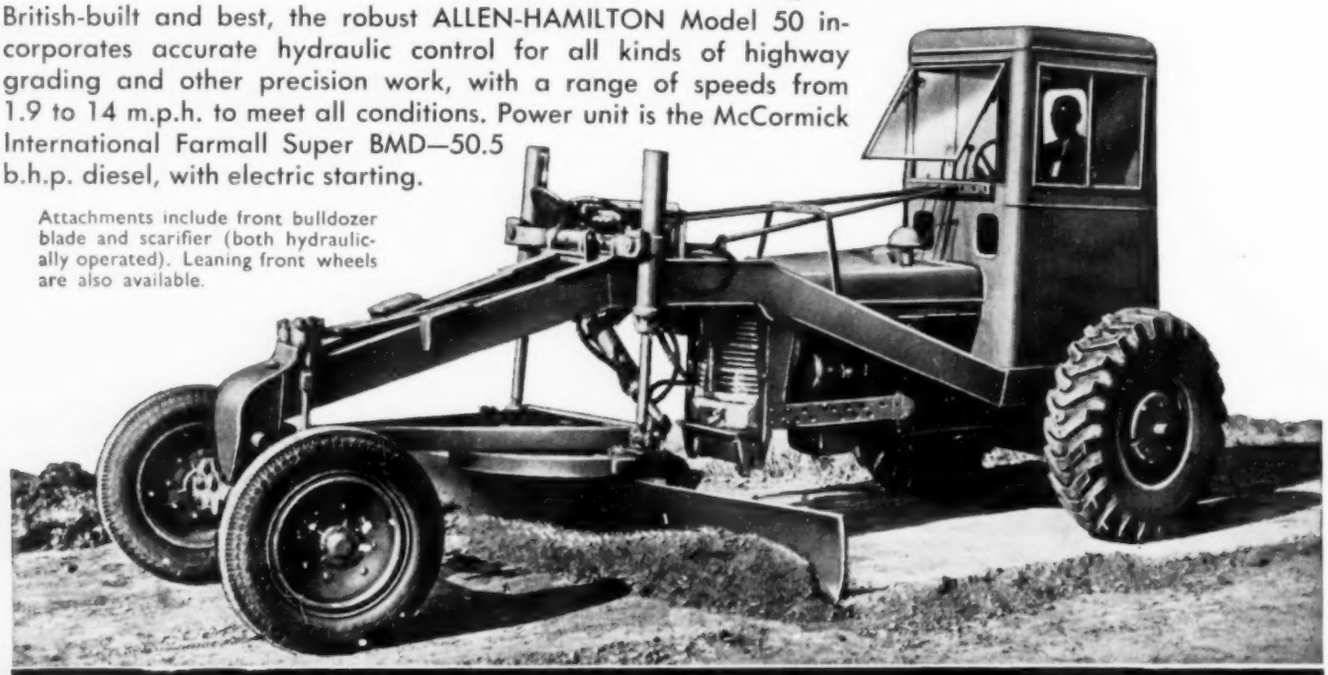
W-K-M *Valves on inlet scrubbers on main line compressor station.*

For complete information, write Dept. J-6 for new W-K-M ASA Through-Conduit Gate Valve Catalog 300.

Here is the ALLEN-HAMILTON *a precision power grader*

British-built and best, the robust ALLEN-HAMILTON Model 50 incorporates accurate hydraulic control for all kinds of highway grading and other precision work, with a range of speeds from 1.9 to 14 m.p.h. to meet all conditions. Power unit is the McCormick International Farmall Super BMD—50.5 b.h.p. diesel, with electric starting.

Attachments include front bulldozer blade and scarifier (both hydraulically operated). Leaning front wheels are also available.



JOHN ALLEN & SONS (OXFORD) LTD COWLEY OXFORD ENGLAND

KEEP PURE DRINKING WATER ALWAYS HANDY

insist on the highest quality

Gotkool water cans and coolers

Specify **"GOTKOOL"** the next time you order water cans or coolers. **"GOTKOOL'S"** exclusive construction keeps water cooler . . . fresher . . . purer. Extra wide, snug-fitting, splash-proof top keeps out impurities. Non-leaking, push-button faucets, either extended or recessed flush-mounted. *Buy* **"GOTKOOL"** *at your supply store today.*

GOTKOOL Water Cooler – made in 1½-, 2-, 3-, 5-, 10-, 15-, and 20-gallon sizes with either extended or recessed, flush-mounted faucet. *Note:* 15- and 20-gallon sizes available with extended faucet only.

GOTKOOL Water Can – made in 1½-, 2-, 3-, 5-, 10-, 15-, and 20-gallon sizes without faucet.

Insist on the genuine – look for the *Blue and Black Label* with the name "GOTKOOL" in Red.

H. P. GOTT MFG. CO.
WINFIELD, KANSAS

100% Sales Acceptance on FREE Trial Offer

of the all new

Fisher

"Electronic Witch"

M-SCOPE Pipe Finder

10 Days Free Trial

In your field, 100% of those who take the famous "Electronic Witch" on FREE TRIAL actually purchase it! Here is absolute proof of unsurpassed performance. Outperforms any pipe locator on the market regardless of price.

Test this new Pipe and Cable Finder under YOUR actual working conditions. State on your company purchase order that you want 10 day FREE TRIAL OFFER. Your only expense is the nominal shipping charge.

Only $172.50
with indestructible Fiberglas cabinets.

Send for FREE 1957 CATALOG
Complete Pipe Finding, Leak Detecting and Corrosion Control Equipment.

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Dept. PI-2, Palo Alto, Calif.

Geophysical Instruments Since 1932

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Speed Reducer

The new Falk Bulletin combines in one book complete information on the company's lines of concentric shaft and right angle speed reducers for applications up to 140 hp (up to 72,000 lb.-in output torque). Horsepower and torque ratings are given, as well as dimensions, overhung load and thrust capacities, and application pictures, in the bulletin available from The Falk Corporation.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Meters, Valves

A revised condensed catalog covering Rockwell meters, regulators and valves has been introduced by Rockwell Manufacturing Company. Features of the catalog include photo-illustrated descriptions of the recently introduced Rockwell telapilot—with power pilot loading by remote control—and the Hypregun, a light compact, air-operating valve lubricant gun.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Electric Lanterns

Justrite Manufacturing Company offers an electric lantern manual covering all types of dry cell battery powered electric lanterns, warning lights, searchlights and special purpose lights. Also included are charts showing characteristics of various bulb and battery combinations as well as other pertinent data.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Nuclear Pump Welding

An 11-page illustrated report made available by the Byron Jackson Division of Borg-Warner Corp. outlines welding for nuclear pumping applications. Welding requirements and specific "do's" and "dont's" for nuclear welding are given along with photos and drawings illustrating various nuclear pump welding designs and set-ups.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Anodes

The Duriron Company, Inc. has issued a revised general bulletin giving details on the Duriron and Durichlor impressed current anodes for cathodic protection.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Gasket Cutter

The Garlock Packing Company has published a new bulletin giving details on the company's latest gasket cutter, a versatile tool used for cutting round gaskets from asbestos, rubber, fibre or cork sheets. It can also be used for precision scribing and layout work.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

Air Compressor

A new air compressor to be known as the "Channel-Flo" has been announced by the Ingersoll-Rand Company in an eight-page brochure. It is a two stage, 200 psig rated motorcompressor presently available in 1½ and 2-horsepower sizes. The unit includes the motorcompressor, rubber mounting on an ASME vertical tank, interconnecting piping and fittings and automatic start-and-stop control.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

Arc Power Supply

Details about simplified automatic and semi-automatic welding are described in a brochure about the new M & T controlled arc power supply put out by Metal & Thermit Corporation. This rectifier-type welder supplies current at preset constant voltages to assure more uniform bead shape.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

Crawler Tractor

International Harvester Company has published a bulletin on the 200 hp TD-24, largest in the IH crawler line of seven units. Line drawings illustrate components of the torque converter drive system, the main frame, and a cutaway exposure and explanation of the planet power steering system.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Record Cards

Goulds Pumps Inc. has designed a pump maintenance record card which provides for complete information on installation, application and maintenance. Space is provided on each card to keep a complete record for a period of years.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

QUESTIONS and ANSWERS

How do I get more horsepower from less fuel?

A. — USE

SAND-BANUM Pure Colloidal Concentrate

Ounces Only Once a Week
Remove and Prevent Boiler Scale.

More Power Less Fuel

SAND-BANUM SPECIAL

in Handy Tablet Form
Removes and Prevents Rust and Scale in ALL Radiator Cooling Systems.

Stocked by Leading Supply Houses
Gulf Coast District Representatives

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1717 Chenevert Street, Houston, Texas

AMERICAN SAND-BANUM CO.
ESTABLISHED 1926
MEADOW BROOK NATIONAL BANK BUILDING
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TRY A CLASSIFIED AD IN PIPE LINE INDUSTRY

Idle Equipment – Idle Dollars!
Sell It Through a Classified Ad in Pipe Line Industry.

QUICK ECONOMICAL RESULTFUL

Need Engineers – Technical Personnel? A Classified Ad will get them for you.

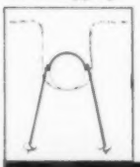
Here's the Fast Easy Way to Anchor Pipelines

No heavy equipment to haul. Cuts costs to a fraction.

Chance Pipe Line Screw Anchors and Brackets greatly simplify pipe line anchoring, compared to other methods, and save many dollars in pipe line construction.

Chance Pipe Line Screw Anchors can be installed in pipe line ditches without extra digging. Using a power wrench the operator merely guides the anchor in place. The tool does the work.

Can be installed in the ditch without extra digging.



Write for catalog showing oil industry applications of Chance Earth Anchors.

A·B·CHANCE CO·
CENTRALIA, MISSOURI
TORONTO, ONTARIO, CANADA

REPAIR LEAKS
QUICKLY—PERMANENTLY

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.

SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

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NOTICE: Specify **PELCO** Welding Saddles

No change except the corporate name. We still have the same ownership, same management, same address, same telephone, and use the same 45 years of experience to render the same service under the same trade name—"PELCO."

PELICAN SUPPLY CO. INC.

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SEE YOUR NEAREST SUPPLY HOUSE

use these

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1. For more data on New Equipment, Catalogs and Literature **reviewed in the editorial columns,** circle on the card below the **Code Number** shown in the item itself.
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Quick-Easy

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E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15
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PIPE LINE INDUSTRY Readers' Service Card **June, 1957, Issue***

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E16	E17	E18	E19	E20	E21	E22	E23	E24	E25					

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120b	120c	121	122a	122b	122c	125	126												

Name (Please Print)_____

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Yellow Strand

. . . always on hand

A Specialist helps you select the wire rope best for your job

You can depend on your Yellow Strand distributor for recommending the right size and type of wire rope — and for ample stocks on hand.

He knows exactly the rope to best fit your equipment for greatest wire rope service. He maintains stocks of standard strength Yellow Strand, Yellow Strand "POWERSTEEL" and Yellow Strand Flattened Strand to promptly supply your needs.

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Yellow Strand®

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Manufacturers of Wire Rope for over 80 Years

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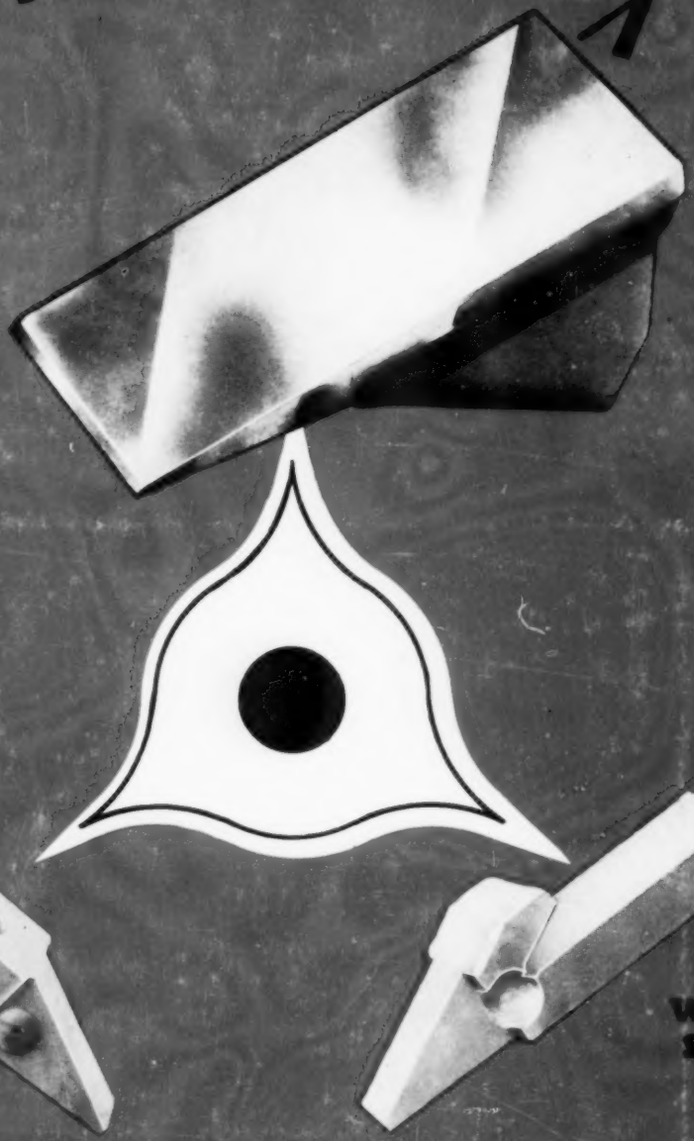

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